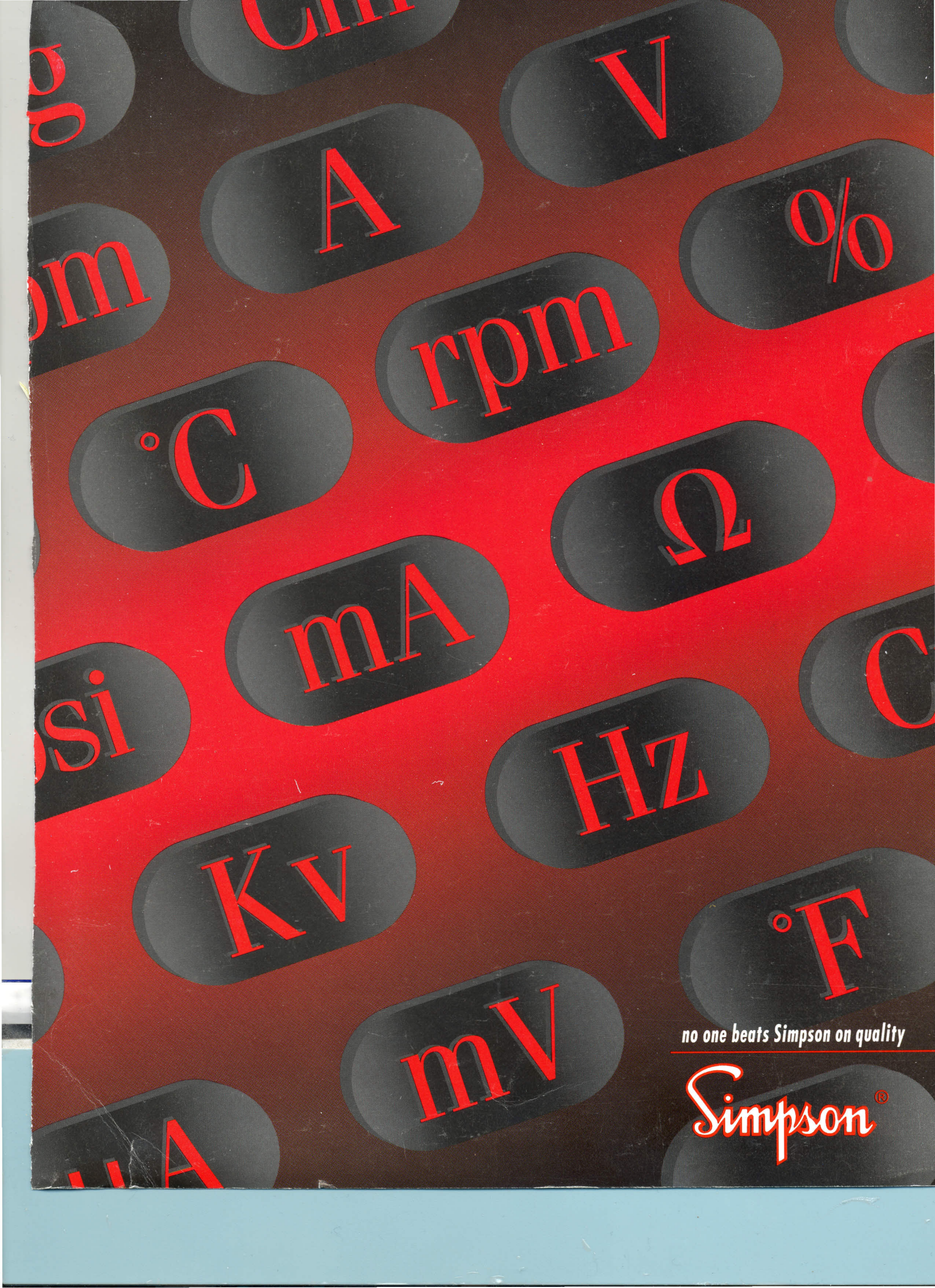




no one beats Simpson on quality

Simpson[®]

No one beats Simpson on quality.



Period. End quote.

When you ask our customers why they buy Simpson products, the word quality has a way of coming up a lot. Customers select Simpson because they want more accurate, constant readings. Durable, reliable performance. Along with easy installation and programming. And with Simpson, you get it. "The best value—because they're constant." That's how one Simpson customer recently phrased it. Bottom line, this means that the full line of Simpson Hawk, Falcon, Mini and Mini Max panel meters do a better job of delivering the readings so vital to monitoring your process. Or, as another

of our customers put it: "No drifting. No flicker." Just an accurate, reliable read-out for precise control. "A panel meter that's rugged." Designed to be durable, Simpson's tougher cases stand up to chemical vapors and other challenging plant environments. "Easy to use and program." No panel meter on the market today offers easier installation or programming. "No one beats Simpson on quality." What more can we say? Our customers have said it all. Let us know how we can help you. Write us at Simpson Electric Co., 853 Dundee Avenue, Elgin, IL 60120, or call 1-708-697-2260.

$^{\circ}\text{F}$ A rpm kV Hz Cm V Ω $\%$ mA $^{\circ}\text{C}$
 temperature thermocouple
 DC current
 tachometer
 DC voltage
 frequency
 3-wire potentiometer
 AC/RTMS voltage
 resistance
 process
 AC/RTMS current
 temperature RTD

No one beats Simpson on quality

Simpson®

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Section B Digital Panel Meters and Controllers

Section C Analog Panel Meters and Controllers

Section D Custom / Special Analog Panel indicators

Section E Accessories

Section F Technical

G Glossary

Section H Test Equipment



A Company

A
2

People and Technology Dedicated to Service

Quality Leader for The New Century

Simpson Electric Company is getting a head start on the new century with new products and new ways of making its customers' jobs easier.

A Simpson product begins with the customer and doesn't end until the customer is completely satisfied. Simpson's product — "the whole product" — includes helping customers choose the best solutions for their problems and helping them select the instrument that's right. Customer support, not just now but for years to come, is the Simpson way of doing business.

Leading a scheduled parade of new Simpson products are our Mini-Max and Mini digital indicators; Hawk II micro-processor controllers; field programmable Falcon series indicators, process indicators, and temperature indicators; 4-20 mA isolated and non-isolated transmitters; as well as our expanded line of accessories for new and

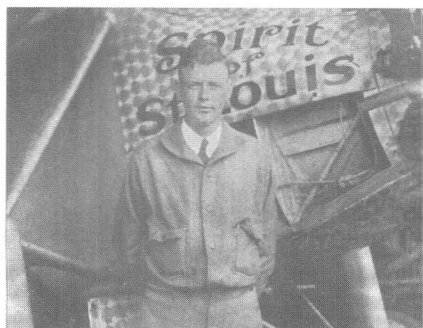


existing products.

You'll find them in this Engineering Application Guide, along with the rest of Simpson's 2,000 products. All our new products are responses to marketplace requirements described by our end users and our worldwide net-

work of distributors and confirmed by our market research.

From Lucky Lindy to Micro-Processor Controls



Milestones

The meter used in the earth-inductor compass in the "Spirit of St. Louis," the plane flown by Charles Lindbergh in his historic trans-Atlantic flight, was developed by Simpson Electric Company.

Later, Simpson developed the 260® Multimeter, the standard in its

field, and world-renowned for over 50 years. In fact, since 1934, Simpson has sold over 5 million 260® Multimeters, a fitting testimony to its acceptance and usefulness in the marketplace. More recently, when NASA needed special two-movement cross-pointer panel instruments for the space program, they came to Simpson Electric.

Driven By Customers

A
3

Quality is Everyone's Job

Teamwork is the key to Simpson's success, and it's emphasized at every step from product concept through introduction.

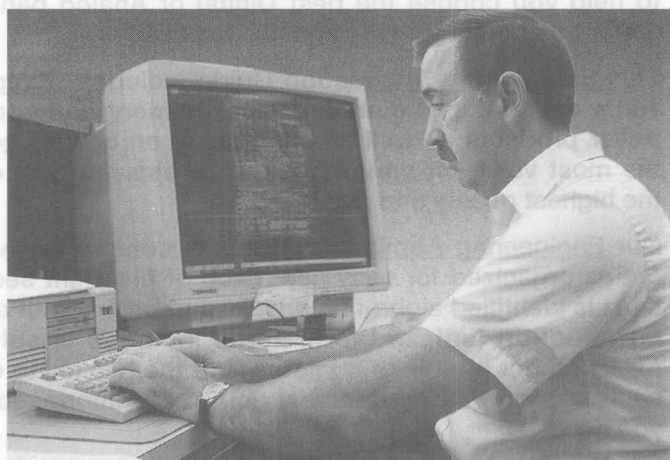
At Simpson, staff groups and manufacturing groups are equally involved in a never-ending process of quality improvement and total commitment to customer satisfaction. By continually providing technical support, training, and a tradition of excellence, we maintain leadership in our industry.

OEMs and end users will find, when doing business with Simpson, that our service never stops. Before the sale, we scrutinize your application

to pinpoint your exact requirements. After the sale we make sure you are getting the performance you expect.

Simpson's Marketing and Engineering responsibilities work hand-in-hand. Once the need for a product is cited, a determination of its feasibility and probable acceptance in the marketplace is made. Only then does design and engineering begin.

If we don't have the product that meets your needs precisely, we'll customize one to match your specifications.



“Tooled Up” for Quality

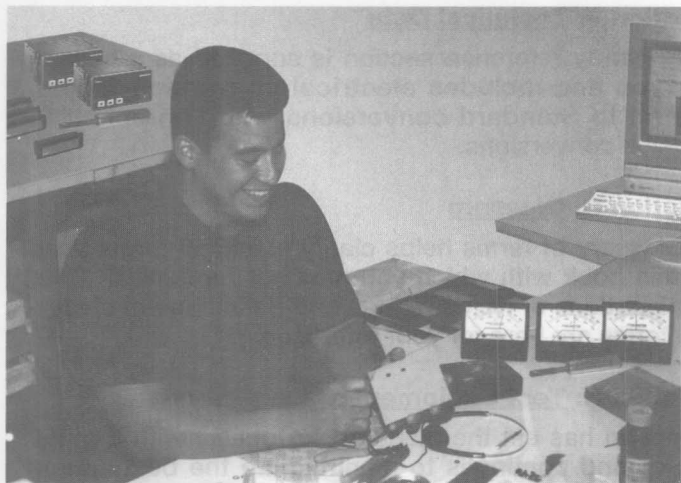
Simpson has been manufacturing and marketing instrumentation products for more than 60 years.

“No One Beats Simpson On Quality” we say in our advertising. Far from being merely a boast, that's a theme we hear consistently from customers who tell of using Simpson products for decades without a problem.

American business will be revitalized by a great crusade for quality in the 21st century. It's a crusade in which Simpson is well-prepared to continue leading the industry.

Operations throughout our company have been computerized for maximum efficiency and quality.

We have realigned our production department to implement Continuous Flow Manufacturing (CFM), a team approach which maximizes quality while yielding faster turnarounds and containing costs. Products are built and quality is assured one order at a time.





Introduction

How to Use this Engineering Application Guide

Simpson's Engineering Application Guide is published to help you choose the best Digital or Analog panel meter instrument for your specific application.

This Engineering Application Guide includes Simpson's entire line of standard measurement and controller products as well as information on how to get the most value for your money while assuring you of the highest quality and reliability.

Our Engineering Application Guide is comprehensive and is organized for easy use. Each of the eight sections is identified alpha-numerically and begins with an introduction (unless the material included is self-explanatory). A table of contents is at the beginning of each section quickly directing you to the information you need.

Section A: Introduction

This section tells you about Simpson's reputation for excellence and its dedicated people. It also includes a Selector Guide to identify some of Simpson's most popular products as well as information on which panel meter is best for your application — Analog or Digital.

Section B: Digital Panel Indicators and Controllers

This section includes Indicators and Controllers for Voltage, Current, Process, Resistance, Temperature, Tachometer, and Frequency measurement. Simpson Indicators are manufactured in 3/64 or 1/8 DIN panel cutouts, and the Controllers are available in 1/8 DIN. Most of the units in this section are available with 3-1/2 or 4-1/2 digit displays. The Tachometer and Resistance Controller have a 4 digit display. Many of the Indicators offer excitation or BCD outputs and the controllers offer Analog, Digital and Relay output options.

Section C: Analog Panel Meters and Controllers

This section shows the wide range of Analog Panel meters manufactured in the United States by Simpson Electric Company. Included in this section are Analog Controllers for On-Off controlling of your process. In addition, a wide range of styles are presented for monitoring Voltage, Current, Wattage, Temperature, and VU signals. Elapsed Time meters are presented in this

section as well as Rugged Seal meters for use in the field or rigorous environmental conditions.

Section D: Custom / Special Analog Panel Meters

If you need a custom dial for an Analog Panel Meter, this section has the information you need. Custom dials or bezels can be easily manufactured with your logo or scale range. In addition, any of our Authorized Service Centers can quickly make Custom Analog Panel meters for your application.

Section E: Panel Meter Accessories

These include Nema 4 covers, Shunts, and Donut Current Transformers. The Nema 4 covers protect 1/8 DIN indicators and controllers in a washdown environment. The shunts monitor a high DC Current signal and emit a corresponding millivolt signal to a DC Voltmeter. A Donut Current Transformer monitors High AC Current, and emits up to 5 AC Amps to an AC Current meter. Voltage Multipliers are also available for AC or DC meters.

Transmitters and Thermocouples are available for our Process and Temperature Indicators and Controllers. A wide selection of custom length Thermocouple wire is shown, with Isolated and Non-Isolated Transmitters for remote monitoring of a Temperature process.

Section F: Technical Data

This handy reference section is supplied as a service for you and includes electrical conversion tables, Metric to Standard conversions, and Fahrenheit to Celsius conversions.

Section G: Glossary

A Glossary of terms helps clarify electrical terms used in this book with which you may not be familiar. Brief explanations of Nema ratings and definitions of electrical terms are here for your reference.

Section H: Test Equipment

Simpson has set the standard for quality with the 260 series and continues to manufacture the best analog test equipment on the market. This high level of quality carries over to our Environmental Test Equipment series which includes Dosimeters, Sound Level meters, and Microwave leak detectors.



no one beats Simpson on quality

Simpson®

DIGITAL INDICATORS

A
6

No one beats

Simpson

on quality

Mini M135 & M145



Mini- Max M235 & M245



Display

3¹/₂, 4¹/₂ DIGIT LCD/
BACKLIGHT LCD

3¹/₂, 4¹/₂ DIGIT LCD/
BACKLIGHT LCD

Functions

FUNCTION

3¹/₂ DIGIT DCV
3¹/₂ DIGIT DCA
4¹/₂ DIGIT DCV
4¹/₂ DIGIT DCA

FUNCTION

DCV
DCA
ACV TRMS
ACA TRMS
PROCESS
(4-20 mA, 1-5 VDC)
FREQUENCY

Power Supply

5 VDC, ± 5 VDC, 9 VDC

120 / 220 VAC
12 / 24 / 48 VDC

Panel Cutout
& Depth

2.68" x .88"
(68 mm x 22.2 mm)
.473"(12 mm)

2.68" x .88"
(68 mm x 22.2 mm)
2.36" (60 mm)

Excitation

N/A

12 VDC

Output Signals

N/A

N/A

5 Amp Relays

N/A

N/A

Connections

12 PIN CONNECTOR
WITH 6" LEADS

SCREW TERMINALS

Nema 4/IP65

N/A

N/A

DIGITAL INDICATORS

Falcon F35 Series



Falcon F45 Series



2800 Series 3 1/2 Digit



A
7

3 1/2 DIGIT LED

FUNCTION

DCV
DCA
ACV / ACV TRMS
ACA / ACA TRMS
PROCESS
(4-20 mA, 1-5 VDC, 0-10 VDC)

4 1/2 DIGIT LED

FUNCTION

DCV
DCA
ACV / ACV TRMS
ACA / ACA TRMS
PROCESS
(4-20 mA, 1-5 VDC, 0-10 VDC)
TEMPERATURE

3 1/2 DIGIT LED

FUNCTION

DCV
DCA
ACV
ACA
TEMPERATURE

110 / 220 VAC
9-32 VDC

3.6" x 1.8"
(92 mm x 45 mm)
3.01" (76.5 mm)

12 VDC & 24 VDC

N/A

N/A

SCREW TERMINALS

OPTIONAL COVER

110 / 220 VAC
9-32 VDC

3.6" x 1.8"
(92 mm x 45 mm)
3.01" (76.5 mm)

12 VDC & 24 VDC

N/A

N/A

SCREW TERMINALS

OPTIONAL COVER

110 / 220 VAC
5 VDC

3.6" x 1.68"
(92 mm x 42.75 mm)
4.27" (109 mm)

N/A

N/A

N/A

EDGE CONNECTOR

N/A

DIGITAL INDICATORS/CONTROLLERS

2800 Series 4 1/2 Digit



Hawk II H235 Series



Hawk HK35, HK40, & HK45 Series



4 1/2 DIGIT LED

FUNCTION

DCV
DCA
ACV TRMS
ACA TRMS
PROCESS
(4-20mA, 0-100% DISPLAY)

3 1/2 Digit LED

FUNCTION

DCV
DCA
ACV
ACA
PROCESS
(4-20mA, 1-5VDC)

3 1/2, 4, 4 1/2 Digit LED

FUNCTION

DCV
DCA
ACV / ACV TRMS
ACA / ACA TRMS
PROCESS
(4-20mA, 1-5VDC)
TEMPERATURE
FREQUENCY
RESISTANCE 3 WIRE
POTENTIOMETER
TACHOMETER

110 / 220 VAC
5 VDC

3.6" x 1.68"
(92 mm x 42.75 mm)
4.27"(109 mm)

N/A

N/A

N/A

EDGE CONNECTOR

N/A

24 / 48 / 110 / 220 VAC

3.6" x 1.8"
(92 mm x 45 mm)
3.56"(90 mm)

12 VDC & 24 VDC

ANALOG

1 OR 2

SCREW TERMINALS

YES

24 / 48 / 110 / 220 VAC
9-32VDC

3.6" x 1.8"
(92 mm x 45 mm)
5.35"(136 mm)

12 VDC & 24 VDC

ANALOG AND DIGITAL

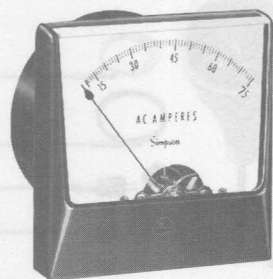
1 OR 2

SCREW TERMINALS

OPTIONAL COVER

Wide View

1 1/2", 2 1/2", 3 1/2", 4 1/2"



FUNCTION

DCV
DCA
ACV
ACA
RFA
VU
WATT (NOT )
PROCESS
DECIBEL
% MOTOR LOAD

Tru - Vue

1 1/2", 2 1/2", 3 1/2",
4 1/2", 4"X6"

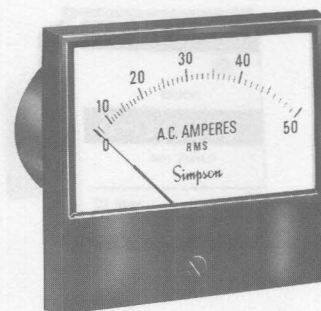


FUNCTION

DCV
DCA
ACV
ACA

Century

1 1/2", 2 1/2", 3 1/2", 4 1/2"



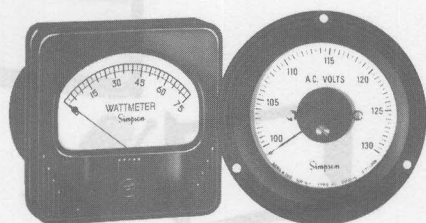
A
9

FUNCTION

DCV
DCA
ACV
ACA
RFA
VU
PROCESS
WATT (NOT )
DECIBEL
% MOTOR LOAD

Round/Rectangular

2 1/2", 3 1/2", 4 1/2"

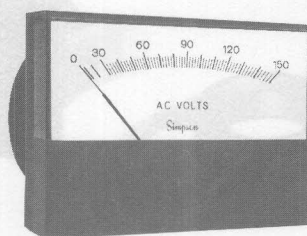


FUNCTION

DCV
DCA
ACV
ACA
RFA
VU
PROCESS
WATT (NOT )
DECIBEL

Designer

3 1/2", 4 1/2"

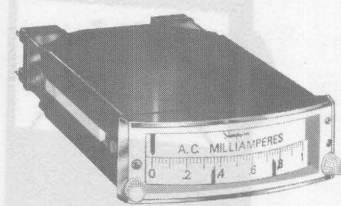


FUNCTION

DCV
DCA
ACV
ACA
VU

Edgewise

1 1/2", 2 1/2", 3 1/2"



FUNCTION

DCV 1 1/2", 2 1/2" DCV 3 1/2"
DCV CONTROLLER
DCA 1 1/2", 2 1/2"
DCA 3 1/2"
DCA CONTROLLER
ACV 1 1/2", 2 1/2"
ACV CONTROLLER
ACV 3 1/2"
ACA 3 1/2"
ACA CONTROLLER
PROCESS 3 1/2"

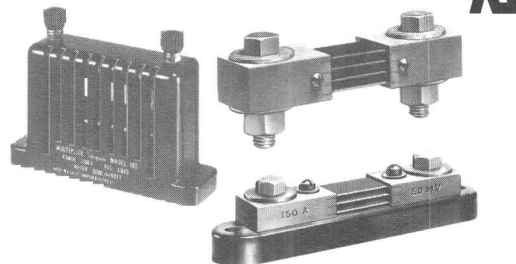
ANALOG PANEL METERS & ACCESSORIES

Elapsed Time

1 1/2", 3 1/2"



Portable/ Switchboard Shunts and Multipliers



Thermocouples and Transmitters



FUNCTION

OPERATING VOLTAGES:
120/240 VAC
10-80 VDC
AVAILABLE STYLES:
WIDE VIEW 3 1/2"
CENTURY 3 1/2"
ROUND 3 1/2"
RECTANGULAR 3 1/2"
112 ET 1 1/2"
109 ET 1 1/2"

FUNCTION

PORTABLE/SWITCHBOARD
SHUNTS, 50 mV
or 100 mV DROP

MODEL 183 MULTIPLIERS
AC to 1000 VOLTS
DC to 5000 VOLTS

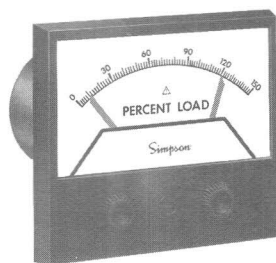
FUNCTION

QUICK DISCONNECT
THERMOCOUPLES,
THERMOCOUPLE WIRE
and THERMOCOUPLE
ACCESSORIES

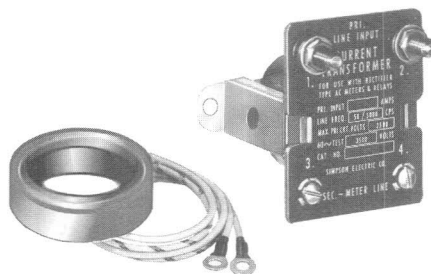
ISOLATED and
NON-ISOLATED 2 WIRE
TRANSMITTERS
(4-20 mA)

Rugged Seal 33 "Series"

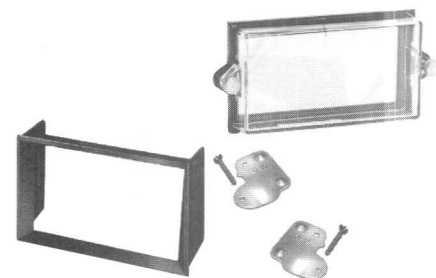
3 1/2", 4 1/2", 4" X 6"



Current Transformers



Other Accessories



FUNCTION

DCV
DCV CONTROLLER
DCA
DCA CONTROLLER
ACV
ACV CONTROLLER
ACA
ACA CONTROLLER
PYROMETER
TEMPERATURE CONTROLLER
% MOTOR LOAD CONTROLLER

FUNCTION

DONUT CURRENT
TRANSFORMERS:
5 AMP SECONDARY

MODEL 186 CURRENT
TRANSFORMERS:
10 VOLT SECONDARY

FUNCTION

1/8 DIN METER ADAPTER
NEMA 4 REMOVABLE COVER

BEZEL KITS:
ANALOG PANEL METERS
MOUNTING KIT
ILLUMINATION KIT
2800 SERIES ADAPTERS
1/8 DIN ADAPTER



Introduction

Which Panel Meter is Best For You — Analog or Digital?

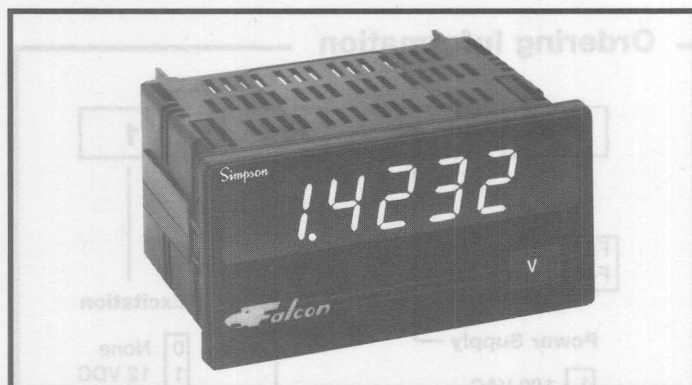
A
1
1

Panel meter users in today's marketplace need to become familiar with the unique advantages common to digital and analog meter design when making their selections. Many already recognize the inherent superiority of the digital meter under certain applications and the value of the analog meter in others. While the enormous popularity and decreasing cost of digital panel meters have made them the choice of many consumers, there are other factors to consider when choosing a panel meter.

When precise measurements and resolution are the foremost

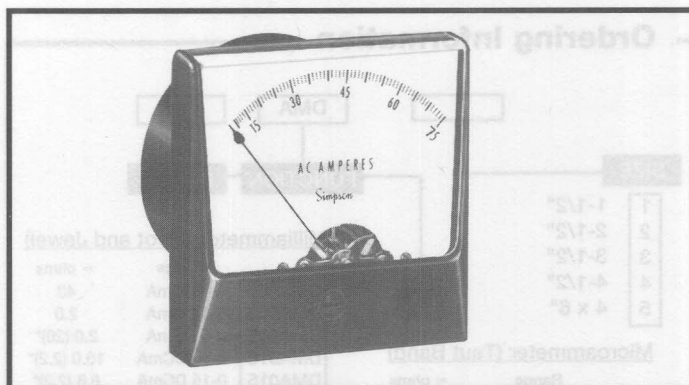
puts in parallel, serial and three-state, RS232 and RS422 serial interfaces suitable for connection between a digital controller and a personal computer, host computer or printer are unique to digital panel meters. 12VDC and 24VDC excitation outputs are available to power ancillary devices such as strain gauge bridges and transmitters, eliminating the need for an external power supply. Analog and relay outputs are also useful options in many monitoring and control applications.

Analog panel meters are preferable to digital where readings tend to fluctuate or oscillate and where extended monitoring



Digital Panel Meter

consideration, a Simpson Digital Panel Meter would be the better choice. Digital panel meters offer accuracies ranging from 1% to 0.02% while the analog counterpart is typically rated at 2%. Digital displays are easily read from 20 feet, under poor lighting and with no parallax problems. (Parallax is an optical illusion caused by viewing an object from an angle rather than direct. Since there is a space between the pointer and the face of the meter scale, an analog pointer will seem to be at different positions on its scale, depending on the angle from which it is read.) Digital panel meters, such as the Simpson Hawk, offer scaling (the capability of the meter to associate, in engineering units, any desired value to the electrical input range). This provides flexibility and versatility for a variety of applications. Additional options such as BCD out-



Analog Panel Meter

is required to indicate trends or rates of change. Digital sampling times may cause reading errors and the highs and lows of the swing cannot be identified. Analog panel meters also provide rugged durability and dependability, withstanding changing outdoor environments. They are generally easier to read in bright sunlight or well-lit rooms. And, unlike the digital meter, the analog meter requires no external power source. Simpson Analog Panel Meters come in a variety of designs made possible through customized dials, mounting options (window, surface and bezel) and a large selection of carrying case styles and sizes.

Simpson panel meter accessories include stock thermocouples, current transformers, external portable and switchboard shunts, and external multipliers.

TECHNICAL SUPPORT

1-708-697-2260

Call Simpson's Customer Service to answer any questions you have on panel instrumentation products or their application. They will give you technical information and the name of your local distributor when you need it ... fast!



Catalog Numbers

Simpson panel instruments and accessories are ordered by 5 digit catalog numbers. These numbers appear on the specific product pages within the Analog, Digital, and Accessory sections. Refer to these numbers when ordering product from Simpson Electric Company or one of our Service Centers.

Analog Custom Catalog Numbers

Tru-View analog meters use a Custom Catalog system for ordering. Selections are made from the list of options, and a catalog number is created. An example is included below.

The meter specified is a 1-1/2" size, 0-50 DC MilliAmp range.

Ordering Information

SIZE

1	1-1/2"
2	2-1/2"
3	3-1/2"
4	4-1/2"
5	4 x 6"

FUNCTION

DC

Range

Milliampmeter (Pivot and Jewel)

Model	Range	≈ ohms
DMA001	0-1 DCmA	43
DMA003	0-3 DCmA	2.0
DMA005	0-5 DCmA	2.0 (20)*
DMA010	0-10 DCmA	10.0 (2.2)*
DMA015	0-15 DCmA	6.6 (2.2)*
DMA020	0-20 DCmA	5.0
DMA025	0-25 DCmA	4.0 (6.0)*
DMA050	0-50 DCmA	2.0 (3.0)*
DMA100	0-100 DCmA	1.0 (1.5)*
DMA150	0-150 DCmA	0.66 (1.0)*
DMA200	0-200 DCmA	0.50 (.75)*
DMA250	0-250 DCmA	0.40 (.60)*
DMA300	0-300 DCmA	0.33 (.50)*
DMA500	0-500 DCmA	0.20 (.30)*
DMA750	0-750 DCmA	0.13

Microammeter (Taut Band)

Model	Range	≈ ohms
TUA010	0-10 DCμA	4900
TUA015	0-15 DCμA	1960 (5500)*
TUA025	0-25 DCμA	1960
TUA050	0-50 DCμA	960
TUA100	0-100 DCμA	500
TUA200	0-200 DCμA	234

DCμA, T.B.: 1-1/2" size only available for ranges 50 μA and above, 4x6" size only available for ranges 100 μA and above.
*Resistance for 1-1/2" sizes shown in ()

Microammeter (Pivot and Jewel)

Model	Range	≈ ohms
DUA050	0-50 DCμA	1800 (5500)
DUA100	0-100 DCμA	1800
DUA200	0-200 DCμA	1100
DUA500	0-500 DCμA	90 (190)*
DUA1H1	100-0-100 DCμA	1100
DUA5H5	500-0-500 DCμA	43

*Resistance for 1-1/2" sizes shown in ()
DCμA, P&J: 0-50 DCμA range not available in 4x6" size.

Current meter (Pivot and Jewel)

Model	Range	≈ ohms
DAA001	0-1 DCA	0.050
DAA002	0-2 DCA	0.025
DAA003	0-3 DCA	0.0166
DAA005	0-5 DCA	0.010
DAA010	0-10 DCA	0.005
DAA015	0-15 DCA	0.0033*
DAA020	0-20 DCA	0.0025*
DAA025	0-25 DCA	0.0020*
DAA030	0-30 DCA	0.0017*
DAA050	0-050 DCA	0.001*
DAA100	0-100 DCA	10.0*
DAA150	0-150 DCA	10.0*
DAA200	0-200 DCA	10.0*
DAA300	0-300 DCA	10.0*
DAA500	0-500 DCA	10.0*
DAA5T5	50-0-50 DCA	0.001

*1-1/2" sizes only - 10 ohms
External current shunts (not included), 50 mV drop, are required with 1-1/2" DC meters, above 10 amps; and on 2-1/2", 3-1/2" and 4x6" DC meters above 50 amps.

The correct Custom Catalog Number to use for ordering the specified meter is:

TV1-DMA-050

Ordering Information

Digital Custom Catalog Numbers

Most Digital Indicators and Controllers use Custom Catalog Numbers to specify the range and power options available. The 2800 series uses standard catalog numbers due to their limited range and power options.

Below is an example of the Custom Catalog Ordering procedure for Digital Indicators. The indicator specified is a 3-1/2 digit unit, 120 VAC powered, with a 4-20 DC Milliamp range, and 12 DC Volt Excitation for powering an external transmitter.

Ordering Information

F35 - **1** - **71** - **1**

Display

F35 3-1/2 Digit
F45 4-1/2 Digit

Power Supply

1 120 VAC
2 220 VAC
3 9-32 VDC

Excitation

0 None
1 12 VDC
2 24 VDC

Range

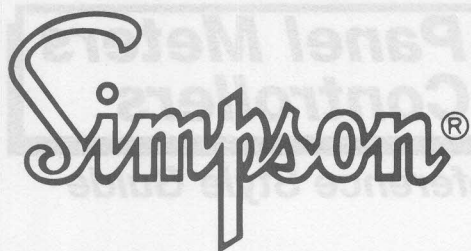
DC	Voltage	AC	AC TRMS
11	200 mV	31	51
12	2 V	32	52
13	20 V	33	53
14	200 V	34	54
15	750 V	35	55

DC	Current	AC	AC TRMS
21	200 μA	41	61
22	2 mA	42	62
23	20 mA	43	63
24	200 mA	44	64
25	2 A	45	65
26	5 A	46	66

DC	Process
71	4-20 mA
72	1-5 V
73	0-10 V

The correct Custom Catalog Number to use for ordering the specified digital meter is:

F35-1-71-1



Digital Panel Indicators and Controllers

Table of Contents

Style/Function Quick Reference Guide	B2	DC Voltage	B105-106
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Mini-Max M235 / M245, 3-1/2 / 4-1/2 Digit.....	B7-10	Mini-Max M235 / M245, 3-1/2 / 4-1/2 Digit.....	B111-114
Falcon F35, 3-1/2 Digit.....	B11-14	Falcon F35, 3-1/2 Digit.....	B115-118
Falcon F45, 4-1/2 Digit.....	B15-18	Falcon F45, 4-1/2 Digit.....	B119-122
2844 / 2845 4-1/2 Digit.....	B19-20	2842 / 2843 4-1/2 Digit.....	B123-124
2869 / 2870 3-1/2 Digit.....	B21-22	2865 / 2866 / 2867 / 2868 3-1/2 Digit.....	B125-126
Hawk II Controller H235, 3-1/2 Digit.....	B23-28	Hawk II Controller H235, 3-1/2 Digit..	B127-132
Hawk Controller HK35 / HK45, 3-1/2 / 4-1/2 Digit.....	B29-36	Hawk Controller HK35 / HK45, 3-1/2 / 4-1/2 Digit.....	B133-140
AC/TRMS Voltage	B37-38	Frequency	B141-142
Mini-Max M235 / M245, 3-1/2 / 4-1/2 Digit.....	B39-42	Mini-Max M235, 3-1/2 Digit	B143-150
Falcon F35, 3-1/2 Digit.....	B43-46	Process	B151-152
Falcon F45, 4-1/2 Digit.....	B47-50	Mini-Max M235 / M245, 3-1/2 / 4-1/2 Digit.....	B153-156
2844 / 2845 4-1/2 Digit.....	B51-52	Falcon F35, 3-1/2 Digit.....	B157-160
2869 / 2870 3-1/2 Digit.....	B53-54	Falcon F45, 4-1/2 Digit.....	B161-164
Hawk II Controller H235, 3-1/2 Digit.....	B55-60	2842 / 2843 4-1/2 Digit.....	B165-166
Hawk Controller HK35 / HK45, 3-1/2 / 4-1/2 Digit	B61-68	Hawk II Controller H235, 3-1/2 Digit..	B167-172
DC Current.....	B69-70	Hawk Controller HK35 / HK45, 3-1/2 / 4-1/2 Digit.....	B173-180
Mini M135, 3-1/2 Digit.....	B71-72	Resistance	B181-188
Mini M145, 4-1/2 Digit.....	B73-74	Hawk Controller HK35 / HK45, Resistance/3-Wire Potentiometer, 3-1/2 / 4-1/2 Digit.	B189-196
Mini-Max M235 / M245 3-1/2 / 4-1/2 Digit.....	B75-78	Tachometer.....	B197-198
Falcon F35, 3-1/2 Digit.....	B79-82	Hawk Controller HK40, 4 Digit	B199-202
Falcon F45, 4-1/2 Digit.....	B83-86	Temperature	B203-204
2842 / 2843 4-1/2 Digit.....	B87-88	Falcon F45, 4-1/2 Digit.....	B205-212
2865 / 2866 / 2867 / 2868 3-1/2 Digit.....	B89-90	2871 / 2872, 3-1/2 Digit.....	
Hawk II Controller H235, 3-1/2 Digit	B91-96	Hawk Controller HK35 / HK45, Thermocouple/RTD 3-1/2 / 4-1/2 Digit.....	
Hawk Controller HK35 / HK45, 3-1/2 / 4-1/2 Digit.....	B97-104		



Digital Panel Meters And Controllers

Quick Reference Style Guide

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Features	Model										
	MINI M135	MINI M145	MINI-MAX M235	MINI-MAX M245	Falcon F35	Falcon F45	HAWK II H235	HAWK HK35	HAWK HK45	2840 Series	2860/70 Series
Size											
NEMA										●	●
1/8 Din					●	●	●	●	●	w/adapter	w/adapter
3/64 Din	●	●	●	●							
Display											
RED LED					●	●	●	●	●	●	●
ORANGE LED											●
Non Backlit LCD	●	●	●	●							
Backlit LCD	Opt	Opt	Opt	Opt							
PGD											
Number of Digits (Resolution)											
3-1/2 Digits	●		●		●		●	●			●
4-1/2 Digits		●		●		●			●	●	
Power Supplies											
120 VAC Power			●	●	●	●	●	●	●	●	●
220 VAC Power			●	●	●	●	●	●	●	Opt	Opt
24/48 VAC Power							●	●	●		
5 V DC Power	●	●								●	●
9-32 VDC Power					●	●		●	●		
Battery Power (9v)	●	●									
12/24/48 VDC Power			●	●							
Functions (Inputs)											
DC Input	●	●	●	●	●	●	●	●	●	●	●
AC Average Input					●	●	●	●	●		●
AC TRMS Input			●	●	●	●		●	●	●	
T/C Input:											
J						●		●	●		●
K						●		●	●		
R						●		●	●		
S						●		●	●		
T						●					
E						●					
RTD Plat						●		●	●		
RTD Ni								●	●		
Frequency			●						● 4-Digit		
Tachometer									● 4-Digit		
Resistance								●	●		
Strain Gauge											
3-Wire Potentiometer								●	●		
Connections											
Screw Terminals			●	●	●	●	●	●	●		
Edge Connector										●	●
Pin Connector w/mating connector & wires	●	●									
Optional Features											
Relay Control							●	●	●		
BCD Out								●	●	●	
Analog Out							●	●	●	●	
Excitation Out			●	●	●	●	●	●	●		
RS 232 / 422 Out								●	●		
Peak Hold								●	●		
Display Hold	●	●	●	Opt	●	●	●	●	●	●	
Scalable Display			●	●	●	●	●	●	●		
Donut Transformer Input			●	●	●	●	●	●	●		
Programmable Setpoints							●	●	●		
NEMA 4 Protection					Opt	Opt	●	Opt	Opt		



Digital Panel Meters

How to specify and get the most for your money

B
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Definition

The basic digital panel meter or DPM measures an input signal and displays the value. Advanced units can power external transducers, act as controllers for processes, or communicate with computers that monitor multiple functions.

The most common use of a DPM is to provide a highly accurate and visible display of the input signal being monitored. Many advanced options are based on what the meter is monitoring and displaying.

Since DPMs come in many sizes and ranges depending on the application, the following points should be considered:

Required Accuracy

The accuracy determines closeness of the display to the signal input. This is stated as a formula such as $\pm(0.1\% \text{ of reading} + 1 \text{ count})$. For example, a 4-1/2 digit meter with an input signal of 10 volts would display $10 \pm(0.1\% + 1 \text{ count})$, or from 9.990 to 10.010 volts, and the last digit would "bounce" up or down 1 count. A higher accuracy meter, such as $\pm(0.02\% + 1 \text{ count})$, would display between 9.998 and 10.002 with the same "bounce" on the last digit. Sometimes the accuracy states + 1 digit instead of + 1 count. The terms are interchangeable.

Simpson DPMs are available in accuracies from 1% to 0.02%. This will vary based on the display, as 4-1/2 digit display units tend to be more accurate than 3-1/2 digit units. When specifying a meter for your application, remember to take into account any accessories required. Thermocouple wire, transmitters, and transducers all have their own accuracy specifications. These specs must be added to the accuracy of the meter to determine correct accuracy of the system.

Resolution of Display

The number of digits on the display determines the resolution of the meter. Simpson manufactures 3-1/2 digit, 4 digit, and 4-1/2 digit DPMs. A 3-1/2 digit display allows the meter direct readings up to 1999 counts, or 1 part in 2000 resolution. For example, if a 3-1/2 digit meter is built to display 2 Amps, it will display 1.999 when a full signal input is applied, and it will have a resolution of 0.001 Amps. An example for a 4-1/2 digit meter is as follows: If the input is 2 amps, the display will indicate 1.9999 and will have a resolution of 0.0001 Amps. Higher resolution is helpful with smaller signal fluctuations because the operator can see small fluctuations in the signal being monitored.

Display Type

Three major display types are available for DPMs: Light Emitting Diode (LED), Planar Gas Discharge, and Liquid Crystal Display (LCD). Simpson meters use LED or LCD displays. LED displays offer excellent viewing in low to moderate indoor lighting. This is ideal for warehouse and manufacturing facilities. LED can be difficult to read under direct bright light, such as sunlight. It has the highest consumer acceptability of the major display types.

LCDs use little power to operate and are the first choice for digital displays on battery power. Usually a dark number is produced on a light-grey background. LCDs offer excellent viewing in bright and moderate light situations and are preferred for outdoor displays. LCDs can be backlit with a positive image or a negative image display. A positive-image display is like an LCD wrist watch with a backlight button, where a couple of LEDs brighten the display so it can be read in low light. A negative-image LCD is opaque, and when a segment is turned on, it becomes clear, and the LEDs behind the display shine through, lighting up the segments, providing a colored display on a dark background.

Planar Gas Discharge offers highest readability in low to moderate light situations. The display is very similar to an LED display. It is not as popular as the LED display because cost is higher, and LED is a close second for visibility.

Input Signal Range

DPMs monitor a variety of input variables directly or monitor sensors which step down the signal to a manageable level. Simpson manufactures meters for AC/DC signal control/monitoring as well as temperature and other process variables. With the flexibility and scaling features of Simpson meters, you can monitor a variety of signals.

Generally, it is advisable to select the input range closest to but not less than the input being monitored. For example, with a signal of 80 volts, you would need a 200-volt meter, because a 20-volt meter could not handle the high voltage signal. A 750-volt meter would not be necessary; the 200-volt meter could handle the load and provide one order magnitude better resolution.

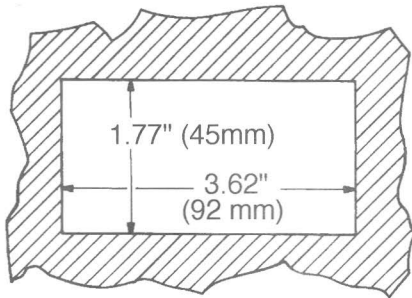
Operating Power Supply

Many power-supply options are available. The most common are 110/220 VAC and 9-32 VDC. Simpson offers 110/220 VAC (at 50-60Hz), 24/48 VAC, 9-32 VDC, 12/24/48 VDC, 5 VDC, +5 VDC, ± 5 VDC and 9 VDC. Loop-powered meters derive power from the 4-20 mA

loop they are monitoring, requiring only a small voltage drop. Loop-powered systems are ideal for noisy electrical situations, as the system is closed from external power lines running to it.

Size

Panel requirements and depth restrictions are extremely tricky. By moving to the DIN standard of measurement, it has become easier to measure a panel space and fit a meter. Simpson manufactures meters to different DIN standards.



The most common size for DPMs is the 1/8 DIN standard, which takes up 96mm x 48mm (3.78" x 1.89") of panel space and requires a cutout of 92mm x 45mm (3.622" x 1.77"). Simpson's Falcon and Hawk series are 1/8 DIN meters. The 1/16 DIN (48mm x 48mm) size is used most often for counters, timers and PID controllers. It is not widely used as an indicator cutout due to the narrow size, which sacrifices size of the digits. Simpson also manufactures 3/64 DIN meters (Mini and Mini-Max) which require 72mm x 24mm of panel space. Generally, the smaller the meter, the smaller the display. Simpson overcomes this problem by using negative image backlight LCDs that are 0.5", slightly smaller than the standard 0.56" display found in 1/8 DIN LED displays. This presents an LED quality display in a Mini-sized package.

Analog/Digital/Excitation Output

Many indicators and controllers offer analog and digital output signals. Analog output signals such as 4-20 mA or 0-10 V are usually sent to chart recorders or other simple recording devices. As the display increases in value, the analog output increases in value also. For example, 0-100% display with a 4-20 mA output would have a 20 mA output when the display indicates 100%. The output would be 4 mA when the display is 0%. Digital outputs are for communication between the controller and a host computer or a printer. Digital outputs allow communication between the computer and the controller, enabling the computer to monitor the values and parameters of the controller. BCD outputs,

RS232, RS422, and RS485 are examples of digital outputs.

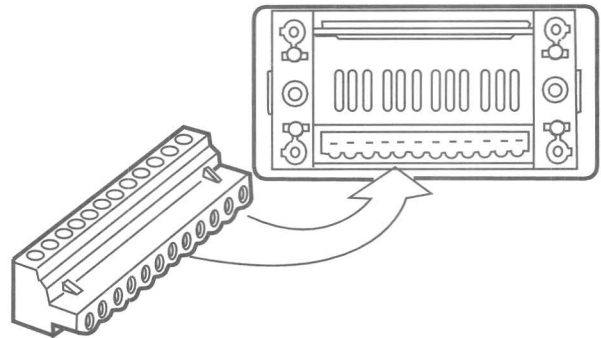
Excitation outputs are available in most Simpson DC indicators and controllers, allowing you to power DC external transmitters. This eliminates the need for expensive DC power sources for 2-wire transmitters and active transducers. The Hawk, Falcon, and Mini-Max series of meters have excitation output capability as an option.

Relay Outputs

Relays are coupled with set points programmed in the controller. The meter takes on control functions when relays are added to the alarm set points. Generally, when a set point for the signal input is exceeded, a relay will be triggered. The relay can be used to turn on or off a light, a process, or an alarm indicator. Simpson offers relays in the Hawk series of controllers. Detailed information on relays is listed in the Controller pages.

Terminal Connections

Terminal connections for DPMs come in several styles. The older style is solder points on an edge connector, requiring that the meter be soldered to the wiring. This makes it difficult to remove later or to calibrate. The newer style is screw terminals, which allow easier attachment and removal of the wiring. Screw terminals hold the wire as well as soldering the wire in, but allow more flexibility in installation. The Mini-Max, Falcon, and Hawk series all have screw terminal connectors. Hawk controllers have a 2-piece connector, with wiring attached to the connector, and the connector then attached to the meter terminal port.



Environmental Protection Requirements

Sometimes dust and water threaten the integrity of a DPM case, and protection is needed so the meter can continue functioning. NEMA has standards for the case integrity of electrical meters. A summary of these ratings can be found in the Technical Section. Simpson has a NEMA 4 cover available for 1/8 DIN indicators and controllers such as the Falcon and Hawk series. The Hawk II controller series has a NEMA 4-rated front panel (when properly installed) without an additional cover required. Other NEMA-rated cases can be found in most distributor catalogs.



AC Current Indicators



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From compact 3/64 DIN mini indicators to 1/8 DIN controllers, Simpson offers a wide range of digital meters to fit your application requirements.

Panel Cutout and Displays

Simpson's line of AC Current indicators/controllers are available in 3 different panel cutout sizes. The Mini-Max indicators are 3/64 DIN, offering compact size with a large 0.5" LCD display. An optional negative image red backlit LCD display is available for the Mini-Max indicators. The Falcon indicators and Hawk/Hawk II controllers are 1/8 DIN size, and both styles have a 0.56" red LED display. The 2800 series indicators require a 92mm by 42.72mm cutout, and have a 0.56" red LED display. The 2800 series offers an optional orange LED display for easier viewing in dark areas.

Signal Measurement

There are two methods of signal measurement available in our AC indicators/controllers: Average Responding, and True RMS measurement. The 2869/2870 indicators and Hawk II controllers are available with Average Responding measurement. The 2844/2845 and Mini-Max Indicators offer True RMS reading only. The Falcon indicators and Hawk controllers offer you a choice of Average Responding or True RMS measurement.

Average responding measurement is a more economical method of measurement, and is ideal for sinusoidal waveforms (the most common type of waveform). Distorted signals, or non-sinusoidal waveforms, require the True RMS method of measurement for better accuracy in the reading.

5 Amp Range

All of the 1/8 DIN indicators/controllers and the Mini-Max have a 5 Amp range, which allows you to use a Donut Current Transformer. This transformer is placed around wiring which carries a higher signal than the

meter could normally handle, and emits up to a 5 Amp signal to the indicator or controller. Simpson carries a line of Donut Current Transformers rated from 50 Amps up to 1000 Amps. If your signal is below 50 Amps, and you require a Donut, it is easy to modify the "turns" on the Donut. See the accessory section for full details on the Donut Current Transformer.

3-1/2 digit meters can display up to 1,999 Amps, and 4-1/2 digit meters can display up to 19,999 Amps.

Donut Current Transformer

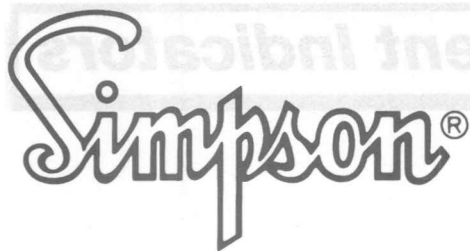


Power Supply

All units feature 120/220 VAC power supply. The 2800 series has an optional 5 VDC power supply, and the Mini-Max offers a choice of 12/24/48 VDC power supply. The Falcon indicators and Hawk controllers have optional 9-32 VDC power supply, and the Hawk/Hawk II controllers have an optional 24/48 VAC power supply.

Display Hold

Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the AC Current signal. The Hawk controller offers a special Peak Hold option for the AC TRMS measuring mode. The Peak Hold option will show the peak value, or spike, of the signal being monitored, then slowly decay to the current value of the signal.

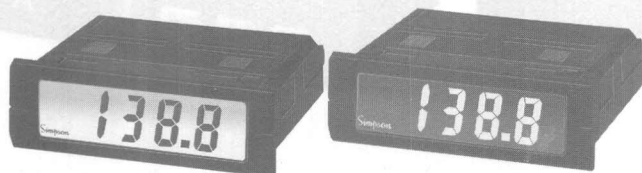


AC Current Indicators

Output Signals

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in either the Hawk or Hawk II controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are stan-

dard programmable features to minimize relay chatter. The Hawk II offers Analog output signals (4-20 mA, 0-1 V, and 0-10 V signals) as an option. The Hawk controller offers optional Analog or Digital output signals, such as RS 232/RS 422, as well as BCD output signals.



With a 3/64 DIN cutout and 60 mm depth, Mini-Max fits small spaces easily. Available in 3-1/2 or 4-1/2 digit LCD or an optional negative image, red backlit display. A unique mounting bracket allows easy stacking of multiple units in one panel cutout, eliminating the need to tap multiple holes.



Falcon F35 low cost indicators can monitor 200 μ A through 5 Amps and higher with Donut Current Transformers. These units can monitor AC/AC TRMS signals, and offer broad range scaling to any engineering unit. The F35 can be modified in the field to accept a different range by moving selected jumpers on the main board.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include dual relays, Peak Hold for AC TRMS readings, and Analog/Digital output signals.



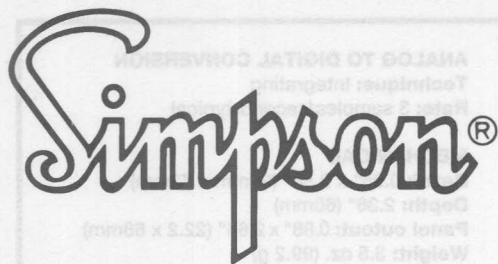
The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. The 4-1/2 digit indicator measures AC TRMS, while the 3-1/2 digit indicator measures Average Responding signals.



The Falcon F45 uses a precision microprocessor design to monitor either AC or AC TRMS signals. The high quality, 4-1/2 digit display can be protected by an optional NEMA 4 cover. Range selection and decimal point can be changed in the field by jumpers on the main board. In addition, the display can be easily scaled to any engineering unit.



The Hawk II controller has a NEMA 4 rated front panel, screw terminals, and display hold. Options include Analog output signals, Excitation output (12 or 24 VDC), and up to two relays. The shallow depth allows easy installation in restricted panel spaces, and the unit can be powered by 24/48/120/220 VAC.



AC Current Indicators

MINI MAX M235/M245 Series 3-1/2 & 4-1/2 Digit AC TRMS Indicators

- **Shallow Depth Indicator! Less Than 2.5" (60 mm) of Space Required Behind the Panel**
- **Fits 3/64 DIN Standard Cutout, 22.2mm x 68mm**
- **Stackable Mounting Bracket Included for Easy Installation**
- **3-1/2 or 4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Broad Range Display Scaling**
- **Optional Negative Image Bright Red Backlighting**
- **Standard Screw Terminals for Easy Installation**
- **6 Current Ranges: 200μA, 2mA, 20mA, 200mA, 2 A, 5 A**
- **120/220 VAC, or 12/24/48 VDC Isolated Power**

Simpson's Mini-Max Current Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units offer choice of 3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, and scaling capabilities. Display hold is optionally avail-

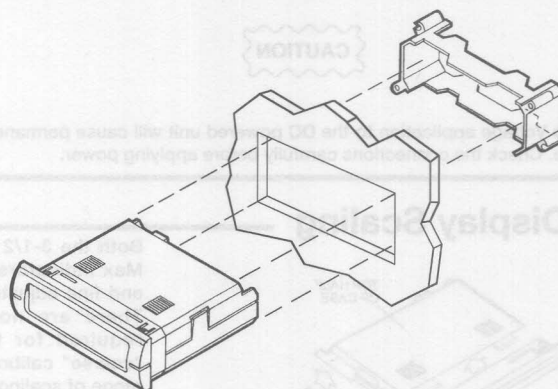
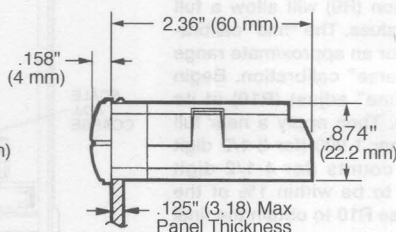
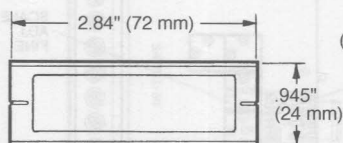
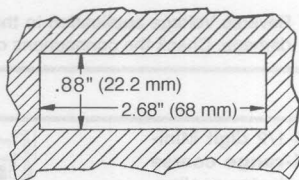
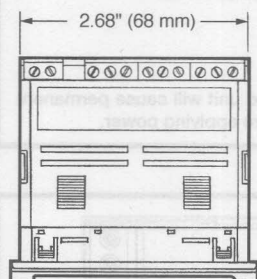
able for the 4-1/2 digit units. A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All Mini-Max units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.



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Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 3 position programmable (3-1/2) or 4 position programmable (4-1/2)

Overrange indication: Most significant digit = "1"

Backlighting: Optional negative image, red LED backlighting

POWER REQUIREMENTS

AC Voltages: 120 (90-132) VAC @40-440 Hz
220 (180-264 Max.) VAC @40-440 Hz

DC Voltages: 12/24/48 VDC ($\pm 10\%$)

Power Consumption:

AC powered units: 3 VA min/12 VA max

DC powered units: 12 V @ 150 mA max;

24 V @ 80 mA max; 48 V @ 50 mA max.

Rated Circuit to Ground Voltage:

750 VRMS

ACCURACY as % of reading @ 25°C:

(@ > 5% of range): 40 Hz - 10 kHz

M235: $\pm(0.5\% + 5 \text{ counts})$

M245: $\pm(0.5\% + 50 \text{ counts})$

5 A range only: (40 Hz - 1 kHz)

M235 3-1/2: $\pm(1\% + 5 \text{ counts})$

M245 4-1/2: $\pm(1\% + 50 \text{ counts})$

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

AC Units: $\pm(0.05\% \text{ of Input } \pm 0.5 \text{ Digit})/^{\circ}\text{C}$

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/ 1 KV unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.95" x 2.84" (24mm x 72mm)

Depth: 2.36" (60mm)

Panel cutout: 0.88" x 2.68" (22.2 x 68mm)

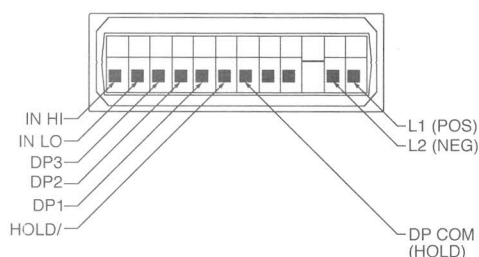
Weight: 3.5 oz. (99.2 g)

INPUTS: AC TRMS Current

Range	Resolution M235	Resolution M245	Voltage Drop	Max Input (unfused)
200 μA	100 nA	10 nA	200mV	10mA
2 mA	1 μA	100 nA	200mV	40mA
20 mA	10 μA	1 μA	200mV	100mA
200 mA	100 μA	10 μA	200mV	400mA
2A	1 mA	100 μA	200mV	3A
5A	10 mA	1mA	200mV	6A

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M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, or DP3) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

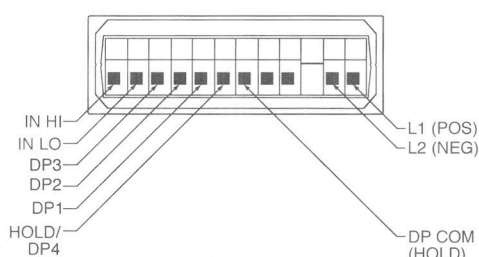
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

M245 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, DP3, or DP 4) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open). Hold is optional with the 4-1/2 digit Mini-Max, and when so equipped replaces DP4. Available through our modification centers.

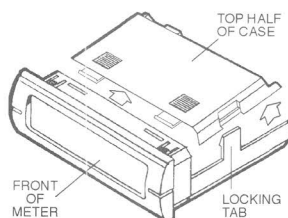
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

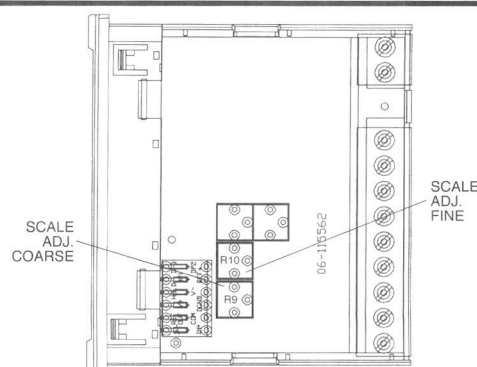
Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

Display Scaling



Using a screwdriver or thumbnail spread tab on each side of case to unlock top half. Lift rear of top half and slide away from front of meter.

Both the 3-1/2 and the 4-1/2 digit Mini-Max indicators have **full-range** coarse and fine adjustments for display scaling. There are no optional connections required for these to function. The "coarse" calibration (R9) will allow a full range of scaling values. The "fine" calibration (R10) allows for an approximate range of 1% of the "coarse" calibration. Begin by placing the "fine" adjust (R10) at its center of rotation. Then apply a near full scale input of either 1,900 (for 3-1/2 digit units) or 19,000 counts (for 4-1/2 digit units). Adjust R9 to be within 1% of the final value, then use R10 to obtain the final desired result.

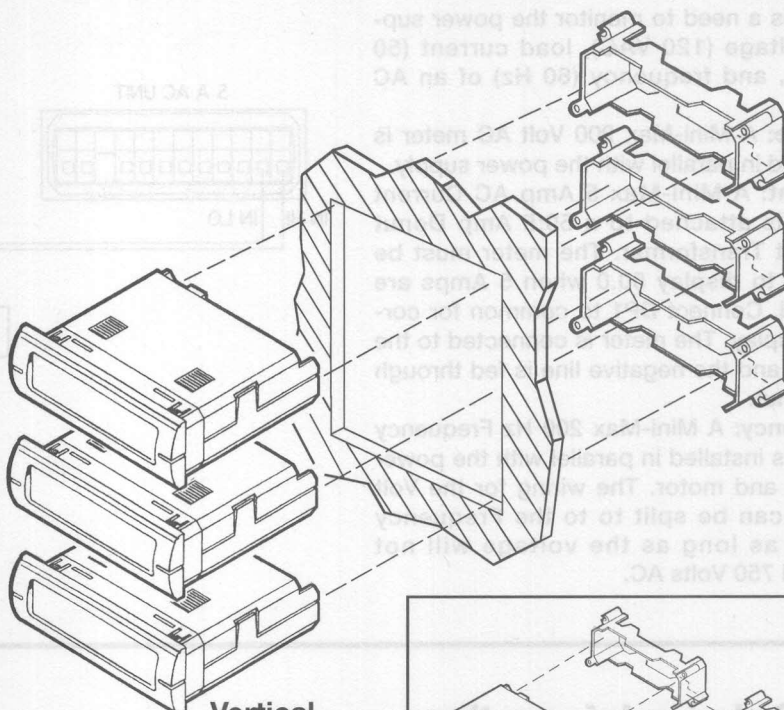


Stacking Features

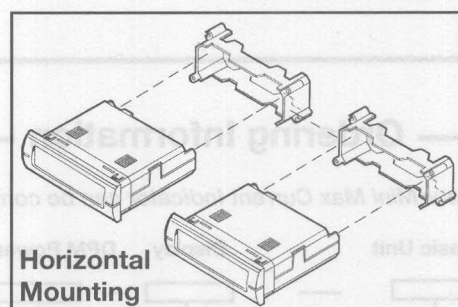
The mounting clips that come with every Mini Max can be connected together. This allows multiple units to be mounted in one hole (no need to punch one hole per meter). Perfect alignment in the panel can be achieved, as only one hole is made.

Perfect for line monitoring applications, Mini Max 3 Packs provide economical and reliable voltage, current, and frequency measurement capabilities in our most popular ranges. The power requirement is 120 VAC.

Mounting the three units is quick and easy. Install the bottom unit first. Place the next mounting clip on top of the previous clip, and slide the meter in place. Repeat this procedure for the top unit.



Vertical Mounting



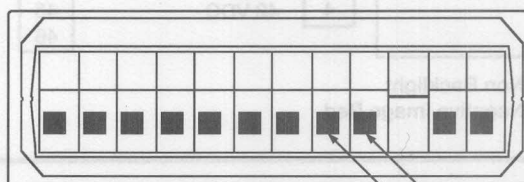
Horizontal Mounting

3-Pack AC Voltage/Frequency/Current Indicators

Type	Voltage	Current	Frequency	Backlight
M35031	200 V	5 A	199.9 Hz	None
M35131	200 V	5 A	199.9 Hz	Negative Red
M35032	750 V	5 A	1999 Hz	None
M35132	750 V	5 A	1999 Hz	Negative Red

Excitation Output

Excitation output is optionally available in the Mini-Max for powering external transmitters or transducers. Excitation is available from the EX POS and EX NEG terminals. This source is isolated from the measurement input as well as the input power circuits. The voltage available is 12 VDC with a maximum load current of 20 milliamps. This feature eliminates the need to mount an external DC power source for transducers or sensors used in your application.



CAUTION

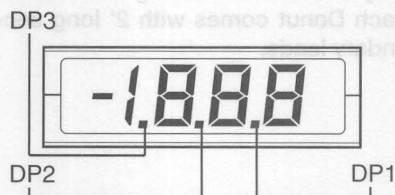
Do not exceed an excitation load current of 20 mA!

EX NEG
EX POS

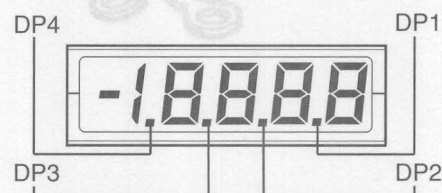
Backlight Option

Negative image, bright red, LED backlighting is available in the Mini Max M235 and M245. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini Max, so no additional external power supply is required.

Decimal Point 3-1/2



Decimal Point 4-1/2



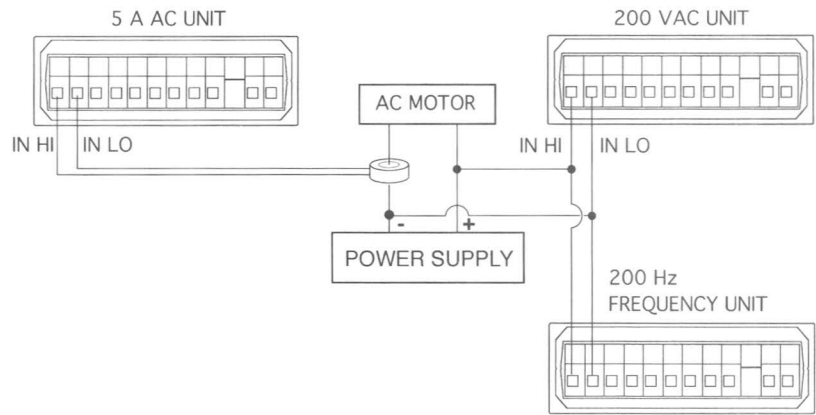
Application Example

There is a need to monitor the power supply voltage (120 VAC), load current (50 Amps), and frequency (60 Hz) of an AC motor.

Voltage: A Mini-Max 200 Volt AC meter is installed in parallel with the power supply.

Current: A Mini-Max 5 Amp AC Current meter is attached to a 50:5 Amp Donut Current Transformer. The meter must be scaled to display 50.0 when 5 Amps are applied. Connect DP1 to common for correct display. The meter is connected to the Donut, and the negative line is fed through the donut.

Frequency: A Mini-Max 200 Hz Frequency meter is installed in parallel with the power supply and motor. The wiring for the Volt meter can be split to to the Frequency meter as long as the voltage will not exceed 750 Volts AC.



Ordering Information

Your Mini Max Current Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Excitation Output
M235 M245	3-1/2 Digit Indicator 4-1/2 Digit Indicator	0 120 VAC 1 220 VAC 2 12 VDC 3 24 VDC 4 48 VDC	41 200uA 42 2mA 43 20mA 44 200mA 45 2A 46 5A	0 None 1 12 VDC
0 1	Non Backlight Negative Image Red			

Safety Symbols

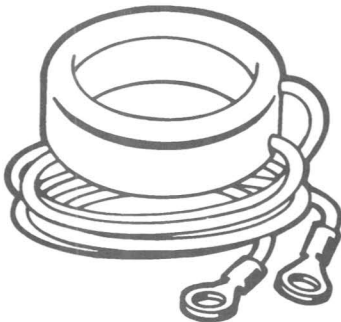
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

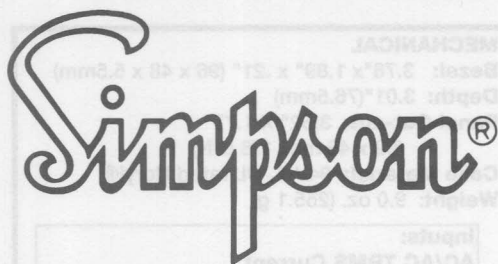
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



Donut Current Transformers enable the Mini-Max to monitor AC Currents above 5 Amps. 3-1/2 Digit units can display up to 1999 Amps. 4-1/2 Digit units can display up to 19999 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. The Mini-Max can be scaled to accurately display the Current being monitored. Each Donut comes with 2' long secondary leads.

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304



AC Current Indicators

Falcon F35 Series AC/AC TRMS 3-1/2 Digit

- Full 3-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 6 User Selectable Ranges: 200 μ A, 2mA, 20mA, 200mA, 2A, 5A
- User Selectable Decimal Point
- Average Responding and TRMS Measurement Ranges
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Supply

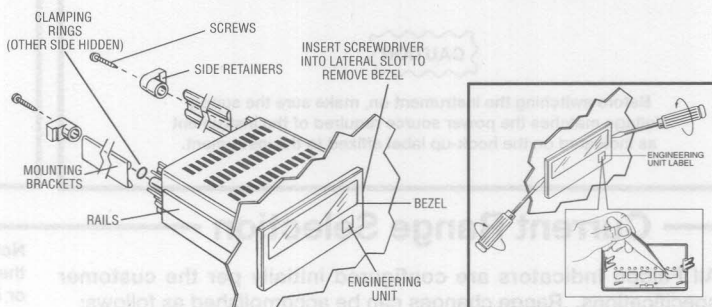
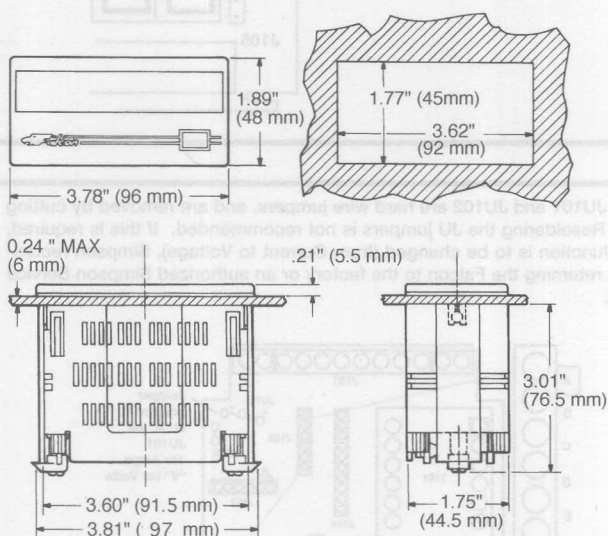


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The Falcon Series digital indicators are premium quality 1/8 DIN meters for industrial applications with display scaling capability. All Falcon units feature jumper selectable decimal point (internal and on the connector for remote decimal point), providing wide application flexibility. In addition, signal input ranges are easy to change with jumpers on the main board. The Falcon has a 0.56" bright red LED display for high

visibility and an optional NEMA 4 cover to protect the display in washdown environments. Compactly designed for applications requiring minimal rear panel depth, the Falcon fits a standard 1/8 DIN panel cutout (92mm x 45mm) and requires only 3.01" behind the panel. A screw terminal connector is a standard feature for easy wiring of the power supply and signal input connections.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove the screws, side retainers, and mounting brackets from the rails as shown above. Position the Falcon into the cutout. From the rear of the panel, slide the panel mounting brackets back onto the rails until the brackets are flush against the back of the panel. Replace the side retainers and screws.

Engineering Label Placement

If replacement of the engineering unit label is required, insert a small screwdriver into the lateral slot on side of bezel and gently turn the screwdriver until the bezel snaps away from the case. Use tweezers to remove and replace the engineering unit label. Gently snap the bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 3 position programmable, internally or on the terminal block.

Overrange indication: 3 least significant digits blank, above 1999 counts.

Polarity: Automatic, with "-" indication, "+" indication implied.

Span: User adjustable up to 1999 counts.

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC

Power Consumption: 3VA

ACCURACY @25° C

$\pm 1\%$ of reading ± 5 counts (45Hz - 1kHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:
($\pm 0.1\%$ of input ± 0.5 count)/°C

Warm-up Time: Less than 15 minutes

Response Time: Less than 3 seconds

NOISE REJECTION

NMRR: 50 dB, 50/60 Hz

CMRR: (w/1 K Ω unbalanced @ 60 Hz):
90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Rate: 3 samples per second, nominal

MECHANICAL

Bezel: 3.78"x 1.89" x .21" (96 x 48 x 5.5mm)

Depth: 3.01"(76.5mm)

Panel Cut-out: 3.62" X 1.77"
(92 x 45 mm, 1/8 DIN)

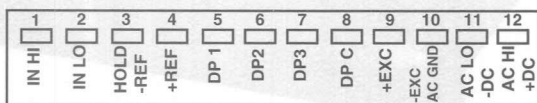
Case Material: 94V-1, UL rated Noryl®

Weight: 9.0 oz. (255.1 g)

Inputs: AC/AC TRMS Current			
Input Range	Display Resolution	Max. Input Current	Voltage Drop
200 μ A	100 nA	20 mA	200 mV
2 mA	1 μ A	20 mA	
20 mA	10 μ A	100 mA	
200 mA	100 μ A	500 mA	
2 A	1 mA	2.2 A	
5 A	10 mA	5.2 A	

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Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. IN HI is terminal #1, IN LO is terminal #2.

Supply Power: Connect the supply power to terminals #11 and #12. Note that if AC power is supplied, terminal #10 is for AC Ground, terminal #11 is for AC Neutral, and terminal #12 is for AC Hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch can be used to make the connection. To activate the display hold, short terminal blocks #3 and #4 (Hold Ref and +Ref).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

Before switching the instrument on, make sure the supply Voltage matches the power source required of the instrument as indicated on the hook-up label affixed to the instrument.

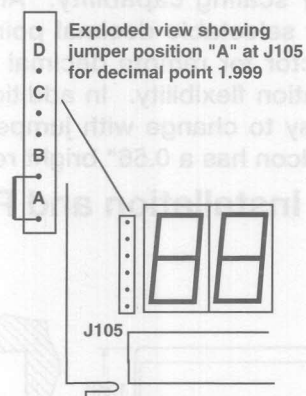
Decimal Point Selection

From terminal block: The decimal point can be set from the rear screw terminal block by connecting the appropriate decimal point (DP 1, 2, or 3) to the DP C terminal. The J105 jumper must be in the D position (see diagram under "From front panel").

Decimal Point	Connect
1.999	DP C to DP1
19.99	DP C to DP2
199.9	DP C to DP3
1999	No Decimal

From front panel: The decimal point can also be selected by removing the front bezel from the meter. Move the push-on jumper J105 across the correct letter.

Decimal Point	Jumper Position at J105
1.999	A
19.99	B
199.9	C
1999	D



Current Range Selection

All Falcon Indicators are configured initially per the customer specifications. Range changes can be accomplished as follows:

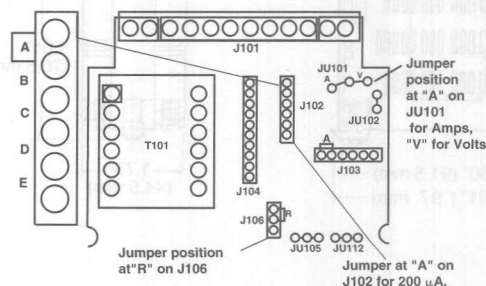
Remove the brackets and side retainers from the unit. Next, remove the O-rings from the two rear posts where the side retainers are screwed in. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

If a new range is selected, the calibration procedure must also be performed. See the chart below for jumper locations.

Input Range	J102	J106	JU101	JU102
200 μ A	A	R	A	NO
2 mA	B	R	A	NO
20 mA	D	R	A	NO
200 mA	E	R	A	NO

If you need to change a Falcon from (or to) a 2 or 5 Amp unit, please consult Simpson Electric Company or an Authorized Service Center.

Note: JU101 and JU102 are hard wire jumpers, and are removed by cutting them. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed (from Current to Voltage), Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center.

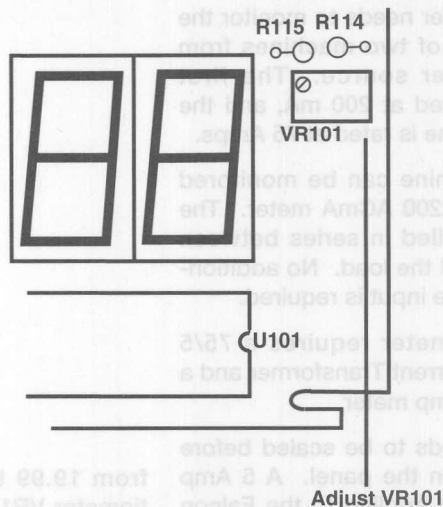


Display Scaling

The Falcon can be easily scaled to indicate any engineering unit. This allows the unit to take in a specified input signal and display a different engineering unit.

For example, if a 200 mA load is being monitored, and you need the meter to display 0-150%:

- 1) Remove the front bezel with a small screwdriver.
- 2) Apply the maximum signal input for the meter (199.9 mA signal).
- 3) Adjust the potentiometer VR101 located on the right side of the display board to display the maximum reading desired (150.0%). The maximum value is adjustable from 1200 - 1999; for other ranges, consult the factory.
- 4) Remove the old Engineering unit label, and replace it with the unit you need (labels are included). Replace the bezel carefully.



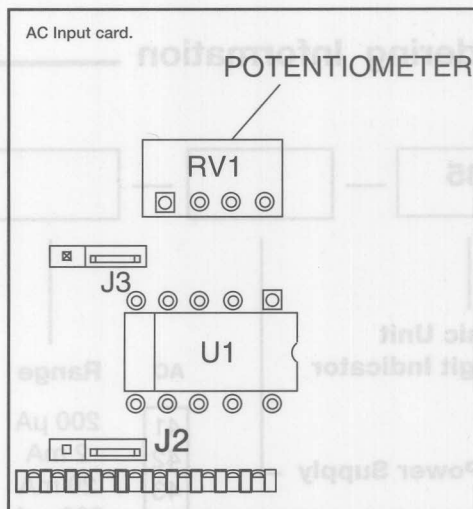
Calibration

WARNING

The following procedure requires opening the unit and removing the top cover with the power ON. Use insulated screwdriver and extreme caution when making these adjustments. It is advisable to have an Authorized Service Center perform this operation, or return the Falcon to the Factory.

The Falcon is calibrated at the factory per order. If you change the range, and have moved the jumpers, your Falcon will need to be recalibrated.

- 1) Remove the bezel with a small screwdriver, and remove O-rings from rear of unit and take off top of unit.
- 2) Short input terminals #1 and #2 (IN HI and IN LO) and adjust potentiometer RV1 on AC Input card until display reads 0 ± 1 count.
- 3) Apply an input signal to terminals #1 and #2, and adjust potentiometer VR101 until the display indicates the value of the signal or desired display value. See diagram in Display Scaling.
- 4) Re-assemble to meter and install it in your panel.

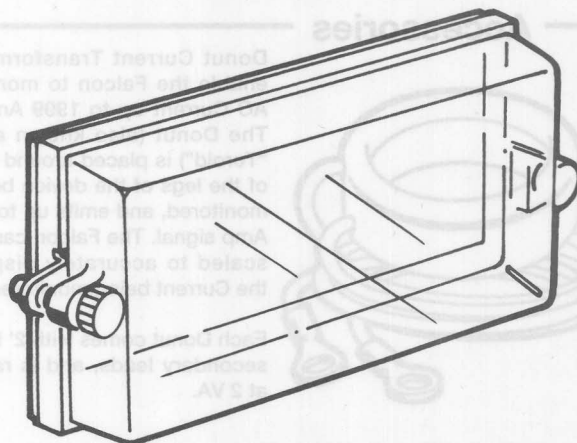


NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Falcon series indicators. This cover will help protect the meter in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Falcon is exposed, and can be removed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the Falcon through the gasket and install the meter into the panel. Then attach the front part of the NEMA 4 cover. Screw the cover on tightly, compressing the gasket about 75%.



Application Example

A plant manager needs to monitor the Current draw of two machines from one AC power source. The first machine is rated at 200 mA, and the second machine is rated at 75 Amps.

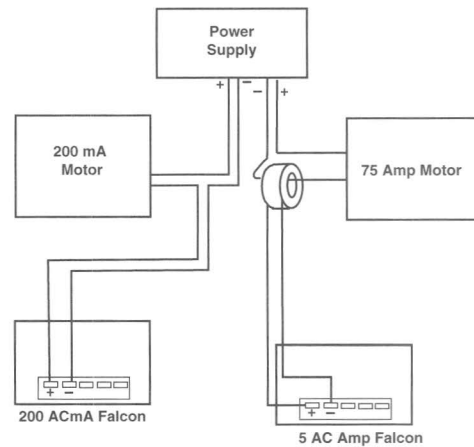
The first machine can be monitored with a Falcon 200 ACmA meter. The meter is installed in series between the source and the load. No additional scaling of the input is required.

The second meter requires a 75/5 Amp Donut Current Transformer and a Falcon 5 AC Amp meter.

The meter needs to be scaled before it is installed in the panel. A 5 Amp signal must be applied to the Falcon (full strength signal from the Donut Transformer). Next, remove the front bezel. Change decimal point position

from 19.99 to 199.9. Adjust potentiometer VR101 until the display indicates 75.0 (Amps) when the 5 Amp signal is on. Replace the bezel, and remove the signal.

The Donut is installed on one of the legs of the motor to be monitored. The meters are installed into the panel, and are ready to operate.



Ordering Information

F35				
Basic Unit				
3-1/2 Digit Indicator				
Power Supply				
1 120 VAC	41 200 μ A	61	0	None
2 220 VAC	42 2 mA	62		
3 9-32 VDC	43 20 mA	63		
	44 200 mA	64		
	45 2 A	65		
	46 5 A	66		
				Nema 4 cover Catalog # 45003

Safety Symbols

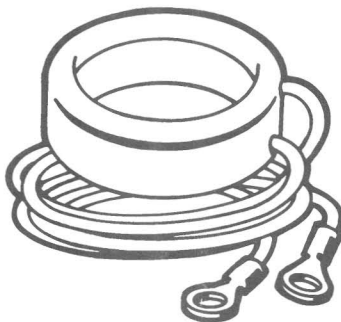
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.



The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

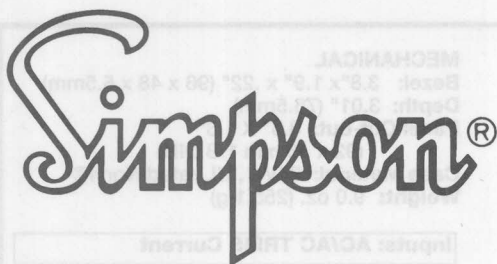


Donut Current Transformers enable the Falcon to monitor AC Current up to 1999 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. The Falcon can be scaled to accurately display the Current being monitored.

Each Donut comes with 2' long secondary leads, and is rated at 2 VA.

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Input	Current Transformer	Dec. Point Position	Range of Reading
20.0 A	5 A	DP 3	20.0 A
25.0 A	5 A	DP 3	25.0 A
50.0 A	5 A	DP 3	50.0 A
75.0 A	5 A	DP 3	75.0 A
100.0 A	5 A	DP 3	100.0 A
200 A	5 A	None	200 A
250 A	5 A	None	250 A
300 A	5 A	None	300 A
400 A	5 A	None	400 A
500 A	5 A	None	500 A
600 A	5 A	None	600 A
750 A	5 A	None	750 A
1000 A	5 A	None	1000 A
For the following inputs, replace jumper R114 with a 63.4K $\pm$ 1% resistor (see Display Scaling)			
15.00 A	5 A	DP 3	15.00 A
150.0 A	5 A	DP 3	150.0 A
1200 A	5 A	None	1200 A
1500 A	5 A	None	1500 A
1999 A	5 A	None	1999 A



AC Current Indicators

Falcon F45 Series AC/ACTRMS 4-1/2 Digit



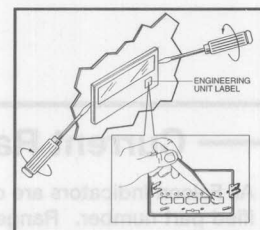
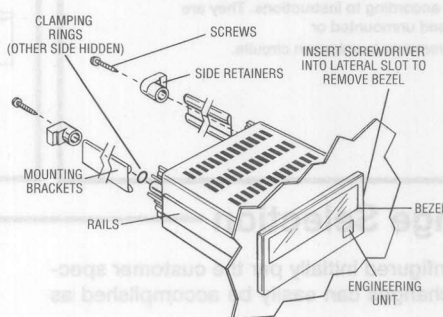
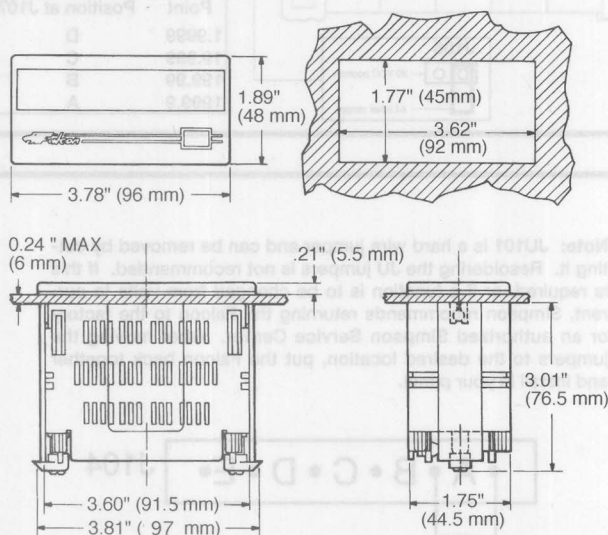
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- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Precision Microprocessor Design
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 6 User Selectable Ranges: 200 μ A, 2mA, 20mA, 200mA, 2A, 5A
- Optional NEMA 4 Splash Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply

The Falcon Series digital indicators are premium quality 1/8 DIN meters for rough industrial applications with multi-function and range capability. All AC and AC TRMS current units feature display scaling and selectable decimal point providing the ultimate in application flexibility. The meter is designed to operate from either 120 VAC, 220 VAC (50 to 400 Hz), or 9

to 32 VDC. For high visibility, the Falcon has a 4-1/2 digit 0.56" bright red LED display and uses precision circuitry to provide a basic accuracy of 0.5% of reading ± 35 counts (45 Hz-1KHz). A screw type terminal block is provided standard for easy installation and a NEMA 4 splash-proof lens cover is available for wash down areas.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 4 position programmable internally or at terminal block J112.

Overrange indication: 1 and 4 LSD blank with polarity sign.

Polarity: Automatic, with "-" indication, "+" indication implied.

Span: User selectable-19999 to +32563 with a scale factor 6 maximum.

Scale Factor:

$$M = \frac{\text{Hi-Lo}}{\text{HiE-LoE}}$$

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC; 9V -1% and 32+1%

Power Consumption: 2VA

ACCURACY @25°C $\pm 0.5\%$ of reading ± 35 counts (45Hz-1kHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

$\pm 0.05\%$ of input ± 0.5 digits/°C

Warm-up Time: Less than 15 minutes

Response Time: Less than 3 seconds

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/1k Ω unbalanced @ 60 Hz):

90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Rate: 2.5 samples per second, nominal

MECHANICAL

Bezel: 3.8"x 1.9" x .22" (96 x 48 x 5.5mm)

Depth: 3.01" (76.5mm)

Panel Cut-out: 3.6" X 1.8" (92 x 45 mm 1/8 DIN)

Case Material: 94V-1, UL rated Noryl®

Weight: 9.0 oz. (255.1 g)

Inputs: AC/AC TRMS Current

Input Range	Display Resolution	Max. Input Current	Voltage Drop
200 μ A	10 nA	20 mA	200 mV
2 mA	100 nA	20 mA	
20 mA	1 μ A	100 mA	
200 mA	10 μ A	500 mA	
2 A	100 μ A	2.2 A	
5 A	250 μ A	5.2 A	

Wiring Diagram

1	2	3	4	5	6	7	8	9	10	11	12
IN HI	IN LO	HOLD	DIG GND	DP 1	DP 2	DP 3	DP 4	EXC	EXC/AC GND	AC LO	AC HI +DC

Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. These are terminals #1 and #2.

Supply Power: Connect the power to terminal #10 for ground and #11 and #12 for neutral and hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Note: AC Ground terminal #10 is used with AC inputs only.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch or computer, etc. can be used to activate this feature. To install this feature, short circuit terminal block J112, Pins 3 and 4 (Hold and DIG GND).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

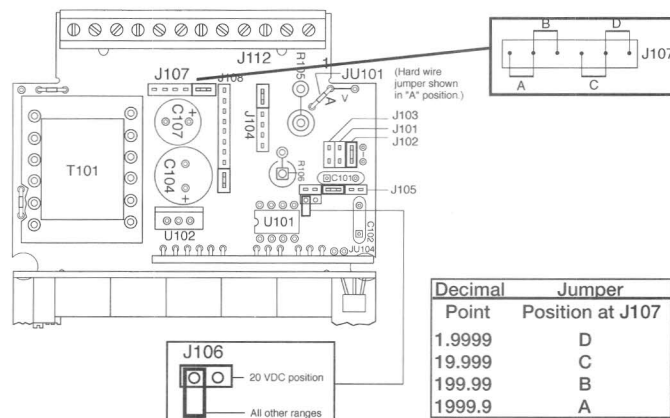
Decimal Point Selection

From terminal block J112: The decimal point can be set from the rear screw terminal block J112. Connect the appropriate DP point (DP 1, 2, 3, 4) to the DIG GND terminal. Internal jumper (J107) should be removed and stored on the last contact of J107.

Decimal Point	Connect
1.9999	DIG GND to DP1
19.999	DIG GND to DP2
199.99	DIG GND to DP3
1999.9	DIG GND to DP4

1	2	3	4	5	6	7	8	9	10	11	12
IN HI	IN LO	HOLD	DIG GND	DP 1	DP 2	DP 3	DP 4	EXC	EXC/AC GND	ACLO-DC	AC HI+DC

From main board: The decimal point can also be selected by removing the top half of meter case. Move the push-on jumper J107 across the correct letter.



Display Scaling

The Falcon display can be easily scaled to display any engineering unit. Remove the front bezel with a small screwdriver. The scaling procedure is performed at terminal J1 located on the left side of the display board. There are four sets of pins on J1 as shown in the drawing. Each group of pins programs a particular parameter of the scaling procedure when a push-on jumper (supplied with Falcon) is momentarily placed across a set of pins.

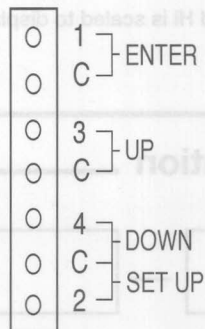
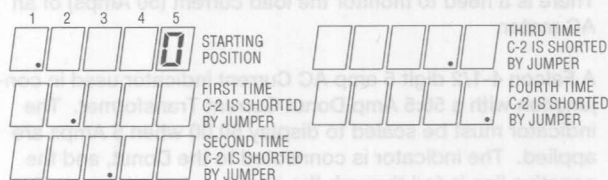
Before scaling the parameters, begin by disconnecting AC power to the Falcon. Place push-on jumper onto "SETUP" pins C and 2. Then apply AC power. At this point the Falcon performs a self test (scrolls LED display showing numerals 1 through 5) and then indicates LoE allowing you to enter the low electrical input value.

The scaling parameters for electrical low input value (LoE), electrical high input value (HiE), display low value (Lo), and display high value (Hi) are performed in the same manner as follows:

Remove push-on jumper from C-2 and then replace. Numeral zero or digit of LoE value (set at the factory) and flashing decimal point are displayed at starting LED position. The digit to be entered is always to the left of the flashing decimal point. The flashing decimal point is moved one position each time the push-on jumper is momentarily placed across "SETUP" pins C and 2. Change the value at the LED position chosen by momentarily placing jumper across "UP" pins C and 3. This will increase the value by 1 for each repetition. Repeat jumper placement until desired value is displayed. To decrease a display value, momentarily place jumper across "down" pins C and 4.

After the desired numeric value is obtained it is necessary to remove the jumper and momentarily place it across the "ENTER" pins C and 1 to store value in memory. LED display indicates next parameter. Repeat this procedure through each parameter.

After programming the last parameter (Hi) of the scaling procedure, LED will display "END" and then indicate scaled value of electrical input to the meter. The unit is now in "run" mode.



Enter-Saves digits displayed and advances to next scaling parameter when jumper makes momentary contact with pins 1 and C.

UP-Changes digit displayed to next ascending value when jumper makes momentary contact with pins 3 and C.

DOWN-Changes digit displayed to next descending value when jumper makes momentary contact with pins 4 and C.

SETUP-Starts scaling cycle of the four scaling parameters (LoE, HiE, Lo and Hi) and selects digit to be entered to the left of the flashing decimal point on display when jumper makes momentary contact with pins 2 and C.

Typical Scaling Application

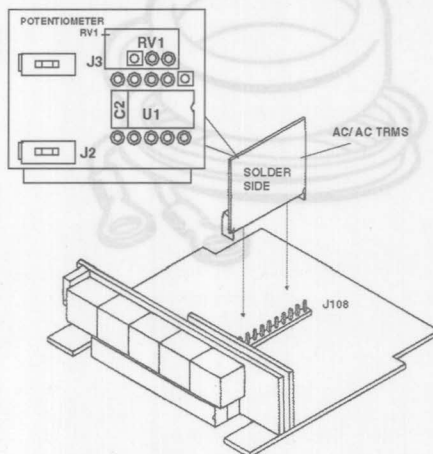
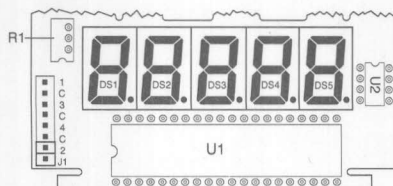
200mA range is used

Electrical Characteristics	Falcon LED Display	
Current: 200mA	LoE: 0	Lo: 0
Display: 100%	HiE: 199.99	Hi: 100.00

Calibration

The unit is calibrated at the factory per order. If you selected another range, and moved the jumpers, your Falcon will need to be recalibrated. If parameters (HiE, etc.) are changed, scaling must be performed prior to calibration.

- 1) Place jumper across J112 screw terminal block terminals 1 (IN HI) and 2 (IN LO).
- 2) Adjust potentiometer RV1 on the AC printed circuit board (plugged into main board) until LED display reads ± 1 count. Replace jumper connected to J112 pins 1 and 2 with AC input signal for full scale value.
- 3) Adjust the potentiometer R1 located on the upper left-hand side of the display board until display shows the full scale voltage.
- 4) Replace bezel carefully



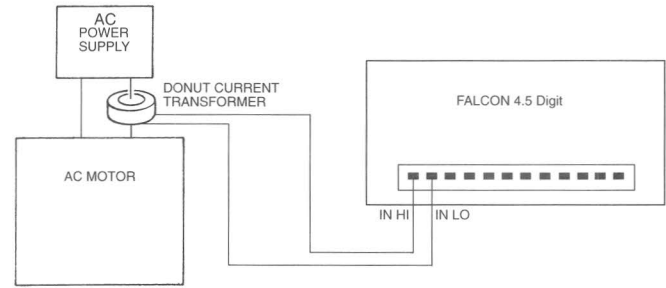
Application Example

There is a need to monitor the load current (50 Amps) of an AC motor.

A Falcon 4-1/2 digit 5 amp AC Current indicator used in conjunction with a 50:5 Amp Donut Current Transformer. The indicator must be scaled to display 50.00 when 5 Amps are applied. The indicator is connected to the Donut, and the negative line is fed through the donut.

LoE should be set at 0 (Amps TRMS)
HiE should be set at 19999 (Amps TRMS)

Lo is scaled to display 0 (Amps) and Hi is scaled to display 50.00 (Amps)



All that is required for this application is a decimal point change.

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Ordering Information

F45			
Basic Unit 4-1/2 Digit Indicator			
Power Supply	AC	Range	AC TRMS Excitation
1 120 VAC	41	200 μ A	61 0 None
2 220 VAC	42	2 mA	62
3 9-32 VDC	43	20 mA	63
	44	200 mA	64
	45	2 A	65
	46	5 A	66
			Nema 4 cover Catalog # 45003

Safety Symbols

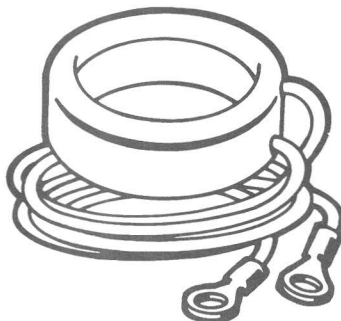
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



Donut Current Transformers enable the Falcon to monitor AC Current up to 19999 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emit up to a 5 Amp signal. The Falcon can be scaled to accurately display the Current being monitored. Each Donut comes with 2' long secondary leads.

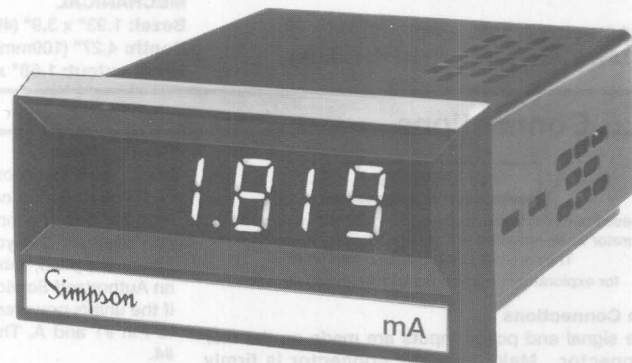
Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304



AC Current Indicators

2844 & 2845 Series TRMS 4-1/2 Digit

- **5 Current Ranges: 20 μ A, 200 μ A, 2 mA, 20 mA, 200 mA**
- **True RMS Responding and Reading**
- **Jumper Selectable Decimal Point**
- **Input/Output Edge Connector**
- **4-1/2 digit, 0.56" Red LED Display**
- **Model 2844 Requires 117 VAC Power Supply**
- **Model 2845 Requires 5 VDC Power Supply**
- **Optional 234 VAC Power Supply**
- **Optional Display Hold**
- **Additional Rear Terminal Connector Available**
- **Optional Cutout Adapters**

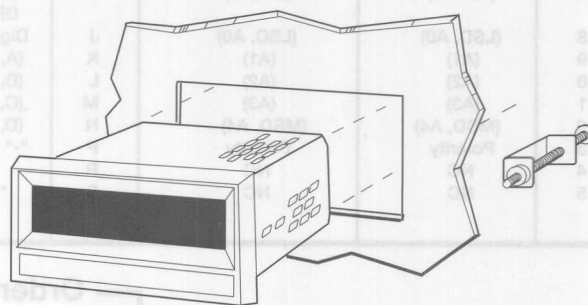
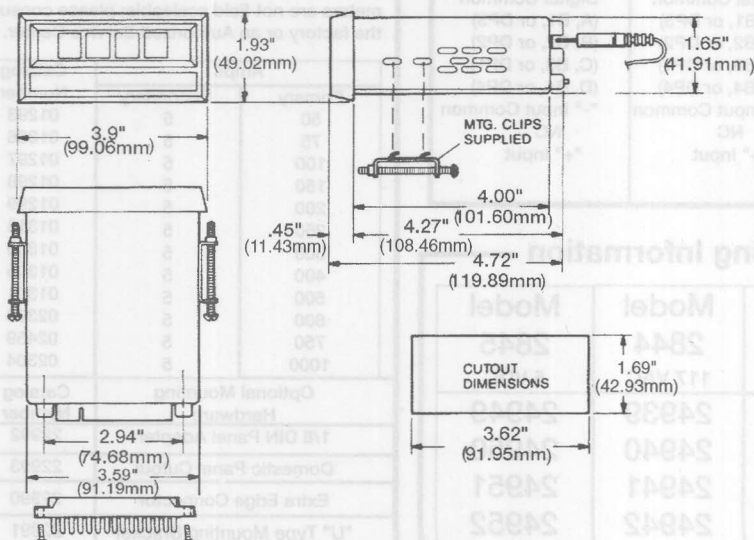


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Simpson's 2844 and 2845 Series meters offer high accuracy with True RMS measurement and resolution to 1 nA. Model 2844 requires a 117 VAC input at 50-400 Hz, and model 2845 requires a 5 VDC input at 500 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 4-1/2 digit display is easily readable

from a distance (about 25 feet). Panel adapters are available for 1/8 DIN panel cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector with a switch (not supplied). The two piece connector makes installation and wiring connections simple.

Installation and Panel Cutout



Mounting Instructions

The 2844 and 2845 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface.

Specifications

DISPLAY

Type: 7 segment, red LED
Height: 0.56" (14.2mm)
Decimal point: Jumper Selectable
Overrange indication: All digits blink "0"

POWER REQUIREMENTS

AC Voltages: 117 V, $\pm 10\%$, 50 Hz to 400 Hz, 6VA
DC Voltages: 5 V, $\pm 5\%$ at 500 mA
Rated Circuit to Ground Voltage: 250 VDC
 (Model 2842) or 5 VDC (Model 2843)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$

$\pm 0.5\%$ of input ± 35 counts (45 Hz to 1KHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -40 to 60 °C
Relative Humidity: 0 to 85%, non-condensing
Temp. Coefficient: $\pm(0.05\%$ of input) per °C
Warmup time: 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope
Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)
Depth: 4.27" (109mm)
Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: AC TRMS Current

Range	Display Resolution	Maximum Input
20 μA	1 nA	5 mA
200 μA	10 nA	15 mA
2 mA	100 nA	20 mA
20 mA	1 μA	100 mA
200 mA	10 μA	500 mA

Voltage Drop on all ranges = 200 mV

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available (cat. #22990). This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

This is an optional feature that needs to be specified when ordering the unit. By shorting Pin H to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This optional feature is available from the factory or one of our Authorized Service Centers.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin #1 and A. The "+" VDC is connected to Pin #4.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Remote Decimal Point

This allows the user to make a connection at the terminal connector to activate different decimal points on the display. This option is available from our factory or an Authorized Service Center.

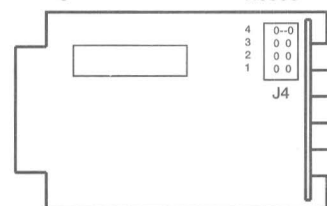
BCD Outputs

The unit is shipped configured with BCD outputs. If Remote Decimal Point is chosen, the BCD output must be disconnected. The unit uses the same connector points for both. Note that this holds true for the Display Hold option also.

Decimal Point

The Decimal Point can be changed by moving Jumper J4 inside the unit. The meter must be disassembled, exposing the main board. The Edge Connector should be removed first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
4	1000.0
1	100.00
2	10.000
3	1.0000



The Jumper Positions are printed on the main circuit board of the meter. After moving the jumper to the location you selected, slide the circuit board back into the meter case and re-assemble the meter.

Accessories

Donut Current Transformers enable meters to monitor AC Current up to 19999 Amps. The Donut emits up to a 5 Amp signal.

Each Donut comes with 2' long secondary leads, and is rated at 2 VA. 2844 and 2845 meters are not field scaleable; please consult the factory or an Authorized Service Center.

Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout	22993
Extra Edge Connector	22990
"U" Type Mounting Bracket	22991

Please see the Accessory section for full details on the Mounting Hardware

Safety Symbols

WARNING

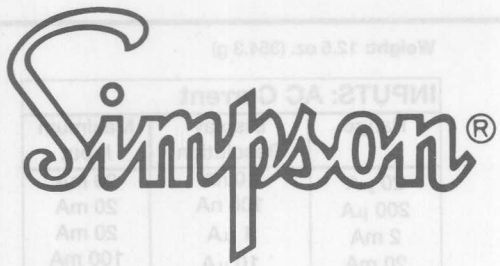
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

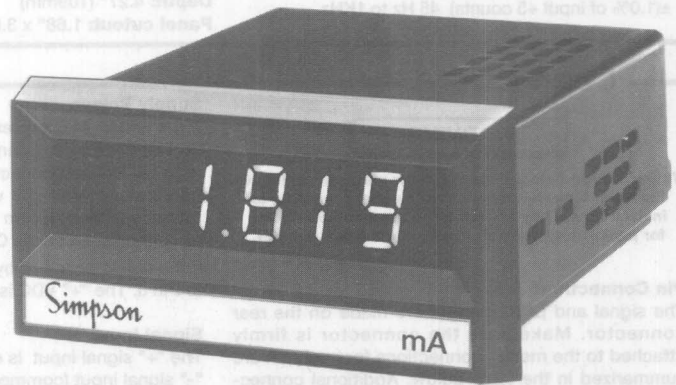
Range	Model 2844	Model 2845
	117 VAC	5 VDC
20 μA	24939	24949
200 μA	24940	24950
2 mA	24941	24951
20 mA	24942	24952
200 mA	24943	24953



AC Current Indicators

2869 & 2870 Series 3-1/2 Digit

- **5 Current Ranges:** 20 μ A, 200 μ A, 2 mA, 20 mA, 200 mA
- **Jumper Selectable Decimal Point**
- **Input/Output Edge Connector**
- **3-1/2 digit, 0.56" Orange LED Display**
- **Model 2869 Requires 117 VAC Power Supply**
- **Model 2870 Requires 5 VDC Power Supply**
- **Optional 234 VAC Power Supply**
- **Additional Rear Terminal Connector Available**
- **Optional "U" Shaped Mounting Bracket**
- **Display Hold Optional**

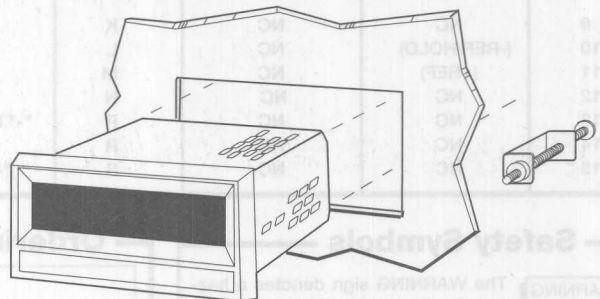
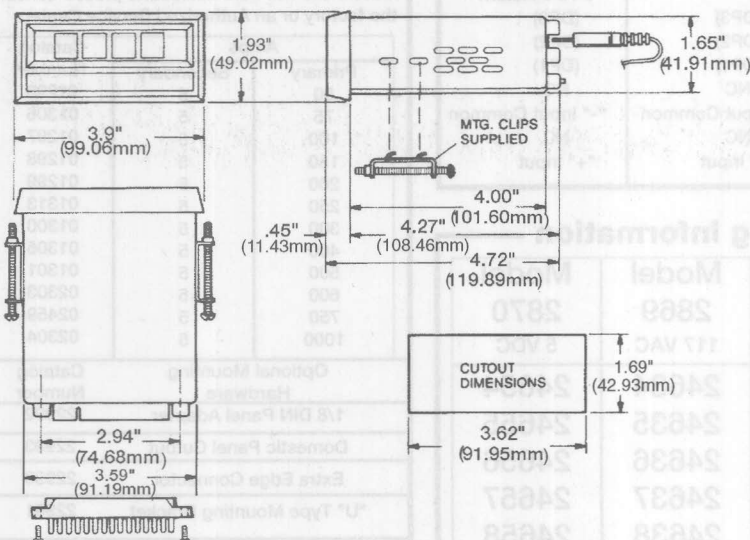


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Simpson's 2869 and 2870 Series meters offer high accuracy with resolution up to 10 nA. Model 2869 requires a 117 VAC input at 50-400 Hz, and model 2870 requires a 5 VDC input at 200 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 3-1/2 digit display is easily readable from a distance (about 25 feet). Panel adapters are available

for 1/8 DIN panel cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied). The two piece connector makes installation and wiring connections easy to work with.

Installation and Panel Cutout



Mounting Instructions

The 2869 and 2870 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface.

Specifications

DISPLAY

Type: 7 segment, orange LED
Height: 0.56" (14.2mm)
Decimal point: Jumper selectable
Overrange indication: All digits blink "0"

POWER REQUIREMENTS

AC Voltages: 117 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA
DC Voltages: 5 V, $\pm 5\%$ at 200 mA
Rated Circuit to Ground Voltage: 250 VDC
 (Model 2869) or -4.06 to +4.5 VDC (Model 2870)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$

$\pm (1.0\% \text{ of input} + 5 \text{ counts})$ 45 Hz to 1KHz

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -40 to 60 °C
Relative Humidity: 0 to 85%, non-condensing
Temp. Coefficient: $\pm (0.1\% \text{ of input})$ per °C
Warmup time: 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope
Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)
Depth: 4.27" (109mm)
Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: AC Current

Range	Display Resolution	Maximum Input
20 μA	10 nA	20 mA
200 μA	100 nA	20 mA
2 mA	1 μA	20 mA
20 mA	10 μA	100 mA
		1 A

Voltage Drop on all ranges = 200 mV

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

By shorting Pin 10 to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This optional feature is available from the factory or from one of our Authorized Service Centers.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin J. The "+" VDC is connected to Pin #4.

Signal Input

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Decimal Point

The unit is shipped with a fixed decimal point based on the range selected. Remote Decimal Point selection and Jumper Selectable Decimal point are available from our factory or an Authorized Service Center as an option when the unit is ordered. These options can be fitted after purchase easily if necessary.

Pin Number	2869 Circuit	2870 Circuit	Pin Number	2869 Circuit	2870 Circuit
1	3rd wire GND	NC	A	3rd wire GND	NC
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	NC	NC	H	DP Common	DP Common
8	NC	NC	J	Digital Common	Digital Common/ 5 VDC Return
9	NC	NC	K	(DP3)	(DP3)
10	(-REF/HOLD)	NC	L	(DP2)	(DP2)
11	(+REF)	NC	M	(DP1)	(DP1)
12	NC	NC	N	NC	NC
13	NC	NC	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

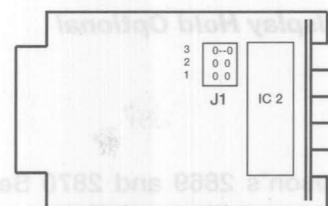
Ordering Information

Range	Model 2869	Model 2870
	117 VAC	5 VDC
20 μA	24634	24654
200 μA	24635	24655
2 mA	24636	24656
20 mA	24637	24657
200 mA	24638	24658

Decimal Point

The Decimal Point can be changed by moving Jumper J1 inside the unit. The meter must be disassembled, exposing the main board. The Edge Connector should be removed first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
1	100.0
2	10.00
3	1.000



The Jumper Positions are printed on the main circuit board of the meter. After moving the jumper to the location you selected, slide the circuit board back into the meter case and reassemble the meter.

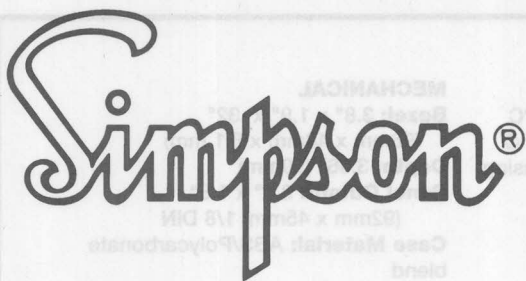
Accessories

Donut Current Transformers enable meters to monitor AC Current up to 1999 Amps. The Donut emits up to a 5 Amp signal.

Each Donut comes with 2' long secondary leads, and is rated at 2 VA. 2869 and 2870 meters are not field scaleable; please consult the factory or an Authorized Service Center.

Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout	22993
Extra Edge Connector	22990
"U" Type Mounting Bracket	22991
Please see the Accessory section for full details on the Mounting Hardware	



AC Current Controllers

HAWK II

Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- Easily Programmed From the Front Panel
- User Friendly Software Functions Include:
 - Password
 - Display Scaling
 - Decimal Point Selection
 - Zero, One, or Two Set Points
 - Peak-Valley Values
 - Time Delay & Hysteresis
- Screw Terminal Connector for Easy Installation
- 1/8 DIN, Shallow Depth Case, 3.5" (89mm) for Restricted Space Behind Panel
- Nema 4 / IP 65 Front Panel
- 6 AC Current Ranges: 200 μ A, 2 mA, 20 mA, 200 mA, 2 A, 5 A
- Optional 5 Amp Relay Outputs, Excitation Outputs, and Analog Outputs.



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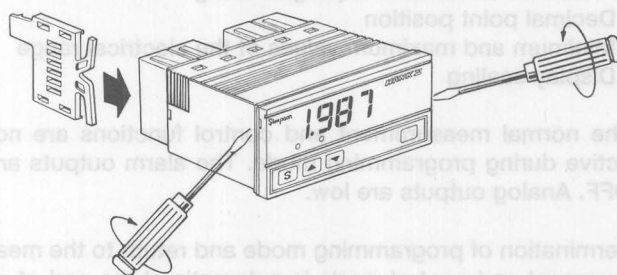
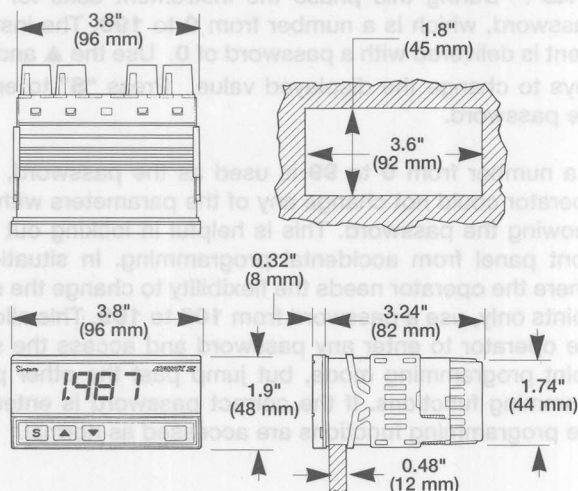
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.

Depending on the password value chosen the customer may lock out all changes, or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm)

Decimal Point: 3 position software programmable from front panel.

Overrange: Display reads "EE".

Underrange: Display reads "-EE".

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230 VAC, $\pm 10\%$

DC Voltages: Future Availability

Power Consumption: 6 VA

ACCURACY @ 25°C:

$\pm 0.3\% \pm 3$ digits

Except 5 A units are $\pm 0.5\% \pm 3$ digits

ENVIRONMENTAL

Operating Temperature: 0°C to +50 °C

Storage Temperature: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 23°C

Temperature Coefficient (per °C):

± 150 ppm/°C

± 0.5 dgt/°C

Except 5 A units are ± 200 PPM / °C

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 Ω

CMRR: 100 dB, GR = 1 K Ω

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32"

(96mm x 48mm x 8.1 mm)

Depth: 3.56" (90mm)

Panel Cutout: 3.6" x 1.8"

(92mm x 45mm) 1/8 DIN

Case Material: ABS/Polycarbonate blend

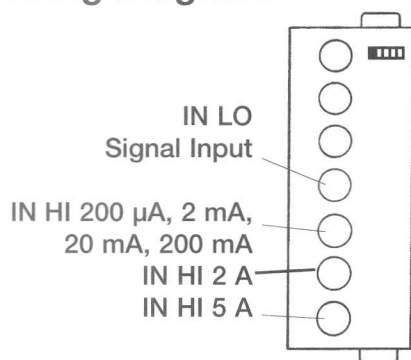
Weight: 10.5 oz. (297.7 g)

INPUTS:

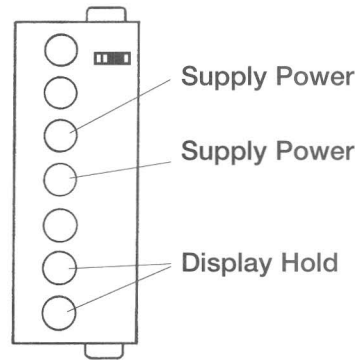
AC CURRENT

Range	Resolution	Voltage Drop	Maximum Overload
200 μ A	0.1 μ A	200 mV	20 mA
2 mA	1 μ A	200 mV	100 mA
20 mA	10 μ A	200 mV	200 mA
200 mA	0.1 mA	200 mV	500 mA
2 A	1 mA	200 mV	4 A
5 A	10 mA	200 mV	8 A
Max 10 Sec			

Wiring Diagram



Input Signal: connect the signal to be monitored to the IN HI and the IN LO terminals. Note that the IN HI signal has three terminals that can be used, depending on the amount of Current being monitored. The upper IN HI terminal accepts 0.2, 2, 20, and 200 mA inputs. The middle IN HI terminal accepts the 2 A input. The lower IN HI terminal accepts the 5 A input.



Supply Power: Connect the power to the supply power terminals. **Display Hold:** Short the terminals marked HOLD to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End"

Access to programming

Press the "S" key and the $\blacktriangle$. The display should show "PAS". During this phase the instrument asks for the password, which is a number from 0 to 199. The instrument is delivered with a password of 0. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "S" to enter the password.

If a number from 0 to 99 is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the set-points only, use a password from 100 to 199. This allows the operator to enter any password and access the set-point programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

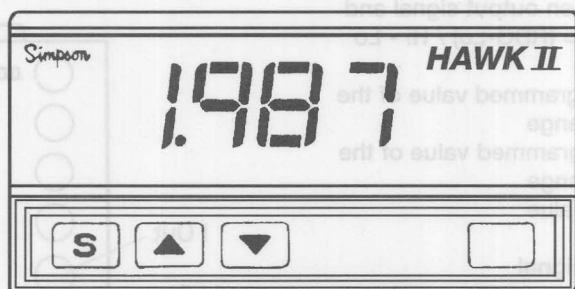
Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from **0** to **199**. Press "S" to move to the next parameter.

Decimal Point Selection

The display will show "dP" for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the ▲ and ▼ keys. Press "S" to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the "S" key. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (LOE to HiE)

Programmed display span: 0 to 100% (LO to Hi)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show "**Hi**" for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the ▲ and ▼ keys to change the displayed value. The maximum is **+1999**. Press the "S" key when the correct value is displayed.

The display will show "**LO**" signifying the minimum of the display span. The display shows the value stored in memory. To modify the value, use the ▲ and ▼ keys. The value can be as low as **0** in the AC Current meter. Press the "S" key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the **Programming the Relays** section.

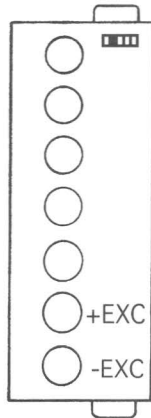
$$\left| \frac{\text{HiE} - \text{LOE}}{\text{Hi} - \text{LO}} \right| \pm 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

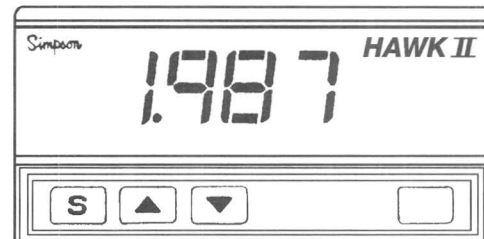
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.



Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi - Lo} (RDG - Lo) + 4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-1 VDC Output signal

Relationship between output signal and displayed value: $V = (RDG - Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-10 VDC Output signal

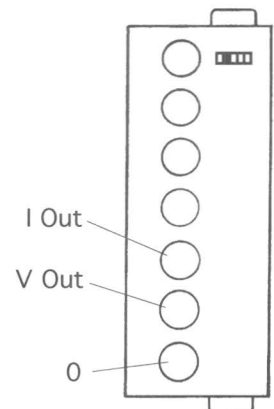
Relationship between output signal and displayed value: $V = 10(RDG - Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-1 V	Output 0-10 V
Overrange	EE	20 mA	1 V	10 V
Underrange	- EE	4 mA	0 V	0 V

NOTE:

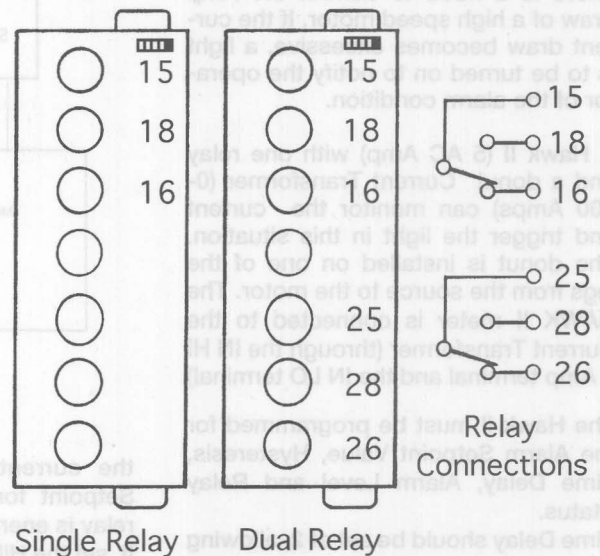
Analog output is not available in conjunction with Excitation

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ C	500 Ohm	N/A	Yes
0-1 V	±1% ±0.005V	±200 ppm/ C	N/A	≤3 Ohm	Yes
0-10 V	±1% ±0.05V	±200 ppm/ C	N/A	≤3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the set points.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **HI** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate "chatter" in the relays. The value is selected from 1 to 1999 counts.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the Setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm) or falls below (Low Alarm) the Setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm; Normally Energized, or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed, and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

There is a need to control the Amp draw of a high speed motor. If the current draw becomes excessive, a light is to be turned on to notify the operator of the alarm condition.

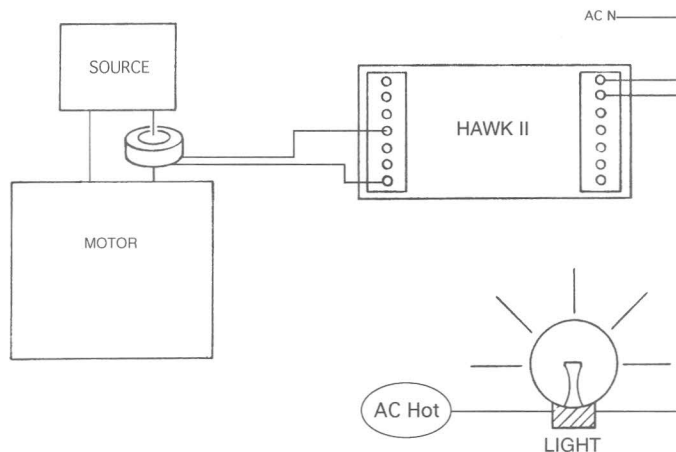
A Hawk II (5 AC Amp) with one relay and a donut Current Transformer (0-300 Amps) can monitor the current and trigger the light in this situation. The donut is installed on one of the legs from the source to the motor. The HAWK II meter is connected to the Current Transformer (through the IN HI 5 Amp terminal and the IN LO terminal)

The Hawk II must be programmed for the Alarm Setpoint Value, Hysteresis, Time Delay, Alarm Level and Relay Status.

Time Delay should be set at 2, allowing

the current to exceed the Alarm Setpoint for 2 seconds before the relay is energized. To scale the Hawk II, set the HiE at 1999 (Amps), and the

LOE at 0. The Hi should be set at 300 (Amps), as this is the range of the Donut, and the LO should be set at 0.



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Ordering Information

Basic Unit		Output Signal		Excitation	
H235	3-1/2 Basic Unit	0	None	0	None
		1	4-20 mA	1	12 VDC
		2	0-1 V	2	24 VDC
		3	0-10 V		
Power Supply		Function/Range		Number of Relays	
1	120 VAC	0410	200 μ A	0	None
2	220 VAC	0420	2 mA	1	One
3	24 VAC	0430	20 mA	2	Two
4	48 VAC	0440	200 mA		
		0450	2 A		
		0460	5 A		

Safety Symbols

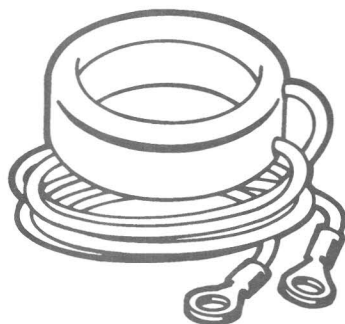
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

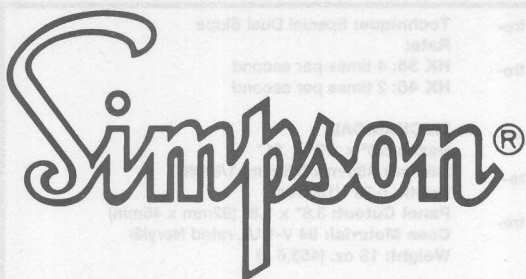
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



Donut Current Transformers enable the HAWK II to monitor AC Current up to 1999 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. The HAWK II can be scaled to accurately display the current being monitored. Each Donut comes with 2' long secondary leads.

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304



AC Current Controllers

Hawk HK35 & HK45 Series AC/AC TRMS 3-1/2 & 4-1/2 Digit

- Easily Programmed from the Front Panel
- Software Functions Include:

Password	Display Scaling
One or Two Setpoints	Decimal Point Selection
Time Delay & Hysteresis	
- 2 Piece Screw Terminal Connector
- 1/8 DIN Case, Made of High Impact Noryl®
- 3-1/2 or 4-1/2 Digit, Bright Red Display
0.56" (14.2 mm) High
- 6 AC Current Ranges: 200 μ A, 2 mA, 20 mA,
200 mA, 2 A, 5 A
- Display Hold
- Optional Nema 4 Front Panel Cover
- Optional 5 Amp Relays and Analog/Digital Outputs



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2
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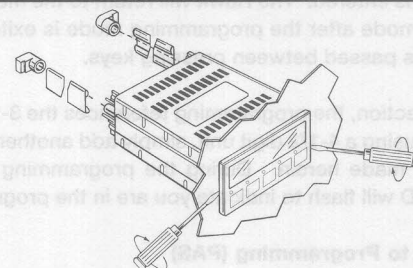
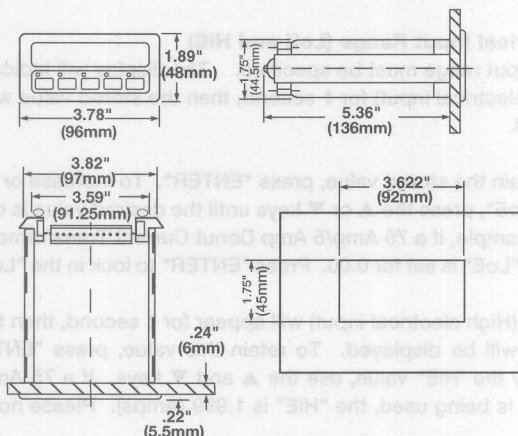
Simpson's Hawk Microprocessor based Controllers/Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Optional Peak Hold is available to replace the standard Display Hold on the AC TRMS units, allowing the operator to observe peak values in the input signal.

Two optional 5 Amp Relays include front programming features for Hysteresis, Time Delay, and Relay operation accessed through the front panel buttons. Optional Analog or Digital outputs are available for use

with chart recorders and computers. Other programmable software features include programmable decimal point and a password lockout feature. By using the password feature, the meter's programming functions and setpoints are protected from accidental reprogramming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact UL-94V 1 plastic Noryl®. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

Engineering Label Replacement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 4 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA

ACCURACY @ 25° C

AC:

HK35: 0.3% of input ± 2 digit (2 A & 5 A ± 5 digits)

HK45: 0.2% of input ± 2 digit (2 A & 5 A ± 5 digits)

AC TRMS:

$\pm (0.2\% \text{ of input } \pm 2 \text{ digit})$ for crest factor ≤ 2 and frequency from 40 to 1 KHz.

$\pm (0.4\% \text{ of input } \pm 5 \text{ digits})$ for crest factor ≤ 3 and frequency from 40 HZ to 1 KHz.

$\pm (0.7\% \text{ of input } \pm 5 \text{ digits})$ for crest factor ≤ 6 and frequency from 40 HZ to 1 KHz.

AC TRMS w/ Peak Hold:

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 2 and frequency from 40 to 1 KHz.

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 3 and frequency from 40 HZ to 1 KHz.

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 6 and frequency from 40 HZ to 1 KHz.

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):

AC: ± 150 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 70 dB (1 K Ω unbalance) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate:

HK 35: 4 times per second

HK 45: 2 times per second

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm) 1/8 DIN

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

Case Material: 94 V-1 UL rated Noryl®

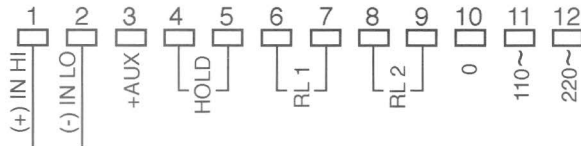
Weight: 16 oz. (453.6 g)

INPUT: AC/AC TRMS Current

Input Range	Resolution		Maximum Overload
	HK 35	HK 45	
200 μ A	100 nA	10 nA	400 mA
2 mA	1 μ A	100 nA	4 mA
20 mA	10 μ A	1 μ A	40 mA
200 mA	100 μ A	10 μ A	400 mA
2 A	1 mA	100 μ A	2.4 A
5 A	2.5 mA	250 μ A	6 A

Voltage drop on all ranges equals 250 mV

Wiring Diagram



Input Signal:

Connect the input signal to the IN HI and the IN LO terminals (#1 and #2).

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Setpoint values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2"

LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" (Low electrical input) for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. For example, if a 75 Amp/5 Amp Donut Current Transformer is being used, "LoE" is set for 0.00. Press "ENTER" to lock in the "LoE" value.

"HiE" (High electrical input) will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the $\blacktriangle$ and $\blacktriangledown$ keys. If a 75 Amp/5 Amp Donut is being used, the "HiE" is 1.999 (Amps). Please note that all

Programming cont.

5 Amp units must have a "HiE" of 1.999, not 5.00. For all ranges other than 5A, HiE equals the full scale electrical input. Press "ENTER" to lock in the new value.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values from shunts or transformers. For example:

Electrical Input Range : 0 to 1.999 (LoE to HiE)

Programmed Display Scaling: 0 to 75 (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. For example, the 75 Amp/5 Amp donut gives off a 5 Amp signal when 75 Amps pass through it. This 5 Amp signal can be scaled to display 75.0 Amps ("Hi") when the meter is receiving a 5 Amp signal. Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The Set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED

will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-energized ("nd"). Press "ENTER" to select the desired setting.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

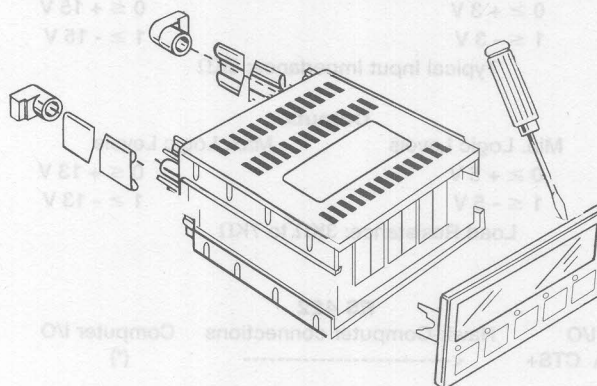
Exiting Programming Mode

After programming the relay(s), the Hawk will automatically exit the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it on to the case. Remove the "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.

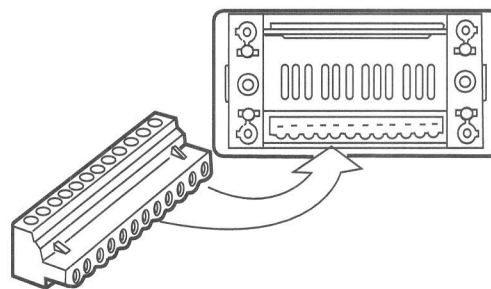


2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder the connections to an edge connector. See your Authorized Hawk Distributor for additional connectors.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up.



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Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3 \text{ V}$	$0 \leq +15 \text{ V}$
$1 \leq -3 \text{ V}$	$1 \geq -15 \text{ V}$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5 \text{ V}$	$0 \leq +13 \text{ V}$
$1 \leq -5 \text{ V}$	$1 \geq -13 \text{ V}$

Load Resistance: 3K Ω to 7K Ω

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<-----	SG

Inputs

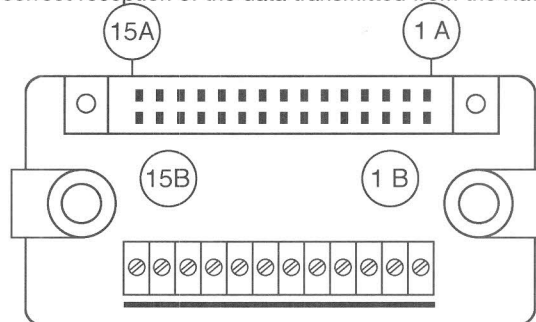
Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2 \text{ V (diff)}$	$0 \leq +12 \text{ V (diff)}$
$1 \leq -0.2 \text{ V (diff)}$	$1 \geq -12 \text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5 \text{ V (diff)}$	$0 \leq +5 \text{ V (diff)}$
$1 \leq -1.5 \text{ V (diff)}$	$1 \geq -5 \text{ V (diff)}$

Termination Resistances : 100 $\Omega \pm 10\%$

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.



CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

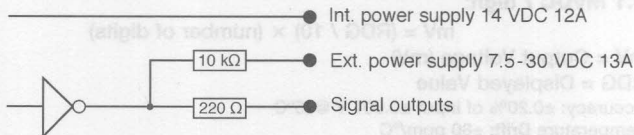
BCD Open Collector Output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A

(*) Negative = logical status 1
Positive = logical status 0



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(1sd)	2nd digit	3rd digit	4th digit	5th digit(msd)
Value Pin	Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B	*10,000 5A
2 2B	20 2A	200 6B	*2,000 10B	
4 3B	40 3A	400 7B	*4,000 11B	
8 4B	80 4A	800 8B	*8,000 12B	

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

(*) Negative = logical status 1
Positive = logical status 0

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

(*) Negative = logical status 1
Positive = logical status 0

The Enable commands (active low) allow you to select the group of data outputs indicated in the table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mADC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for AC/AC TRMS Current controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mADC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mADC:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C(HK 35)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

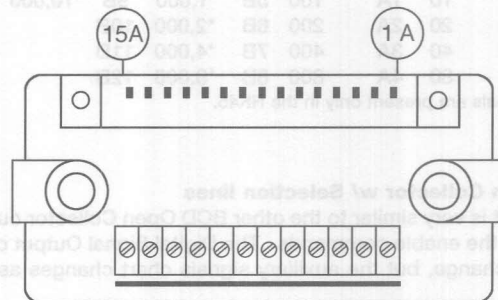
Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit Output Resistance $\leq 3\Omega$

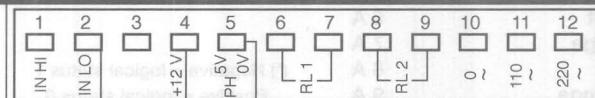
The signal outputs are protected from short circuits.



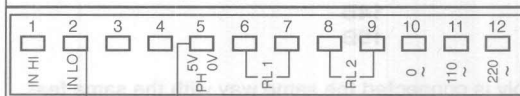
Peak Hold (AC TRMS only)

This optional feature can be controlled internally or externally. The display will briefly "Hold" the peak value, and slowly "decay" to the current input signal. The decay rate is approximately 1 digit per second for the 3-1/2 digit unit, and approximately 5 digits per second for the 4-1/2 digit unit. Display Hold is not available for use when Peak Hold is ordered with the Hawk because the two features use the same terminal contacts.

To measure peak values, apply zero volts DC to the Peak Hold input (terminal #5) by connecting terminal #5 to terminal #2. To clear the reading using the internal source, apply a minimum of 5 VDC through a maximum of 12 VDC to terminal #5. This can be accomplished by connecting terminal #4 to #5. To clear the reading using an external source, connect terminal #5 to an external reference.



Internal Set/Reset Signal



External Set/Reset Signal

+5 V

Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels correspond to the setpoint values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart to the right shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,
4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

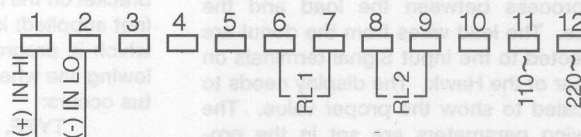
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals # 6 and #7, and relay #2 is wired from terminals #8 and #9.



Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on a process and Alarm light #1 when the current is below 60 Amps, and turn on Alarm light #2 when the current is above 85 Amps.

Setpoint #1 should be set at 60.0, Alarm #1 set at "DOWN", and the relay set at "NE".

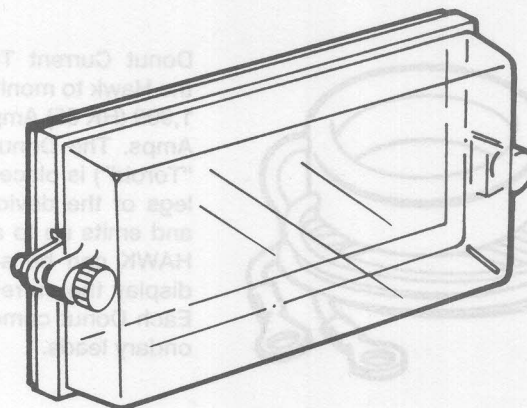
Setpoint #2 should be set at 85.0, Alarm #2 set at "UP", and the relay set at "NE".

NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front, by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the meter through the back half of the cover. Install the meter in the panel, and then screw the front half of the cover over the meter.

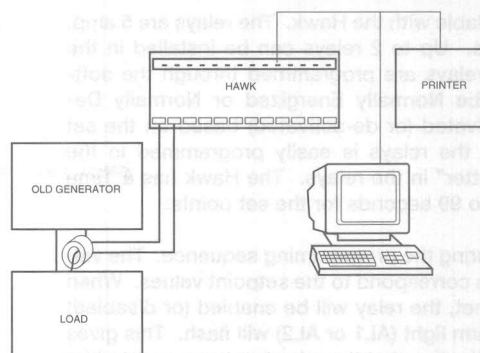


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A Hawk HK35 AC Current (5 Amp) controller with one relay and RS 232 signal output can fill the application need. The relay will be used to trigger the light required, and the RS 232 will be connected to the printer.

LoE -> 0.0 HiE -> 199.9
Lo -> 0.0 Hi -> 150.0
(Hi equals the rating of the donut.)

TYPE, PV, AL1, AL2, STA.
Type is the Activation mode of AL1 or AL2.



TYPE	PV	AL1	AL2	STA
AL1	120.2	ABN	NOR	NOR

Basic unit		Power Supply	Peak Hold*	Output Signal	Relays
35	3-1/2 digit	110/220 VAC	0 None	0 None	0 None
45	4-1/2 digit	24/48 VAC	1 Yes	1 4-20 mA	1 One
		9-32 VDC		2 0-1 V	2 Two
				3 1 mV/digit (HK-35)	
				4 0.1 mV/digit (HK-45)	
				5 RS 232C	
				6 RS 422	
				7 BCD Open Col.	
				8 BCD TRI-STATE	
				9 BCD O.C. W/ SEL. LINES	
				A 0-10 V	
					Excitation
					0 None

* Peak Hold is available for AC TRMS applications only.

NEMA 4 Cover : Catalog # 45003

WARNING

CAUTION

The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304



AC Voltage Indicators



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From compact 3/64 DIN mini indicators to 1/8 DIN controllers, Simpson offers a wide range of digital meters to fit your application requirements.

Panel Cutout and Displays

Simpson's line of AC Voltage indicators/controllers are available in 3 different panel cutout sizes. The Mini-Max indicators are 3/64 DIN, offering compact size with a large 0.5" LCD display. An optional negative image, red backlit LCD display is available for the Mini-Max indicators. The Falcon indicators and Hawk/Hawk II controllers are 1/8 DIN size, and both styles have 0.56" red LED displays. The 2800 series indicators require a 92mm by 42.72 mm cutout, and offer the same 0.56" LED display. The 2869 and 2870 indicators offer an orange LED display, allowing easier viewing in darker areas.

Signal Measurement

There are two methods of signal measurement available in our AC indicators/controllers: Average Responding, and True RMS measurement. The 2869/2870 indicators and Hawk II controllers are available in Average Responding measurement. The 2844/2845 and Mini-Max indicators are available with True RMS reading. The Falcon indicators and Hawk controllers offer you a choice of Average Responding or True RMS measurement.

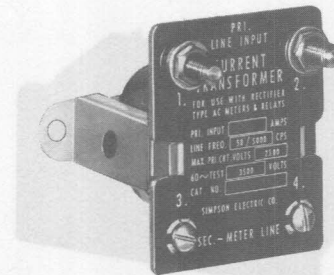
Average responding measurement is a more economical method of measurement, and is ideal for sinusoidal waveforms. This is the most common type of waveform. Distorted signals, or non-sinusoidal waveforms, require the True RMS method of measurement.

Transformer Monitor

All of Simpson's indicators and controllers have a 20 Volt range, which allows you to use a model 186 Current transformer. The transformer monitors a current signal and emits a 0-10 Volt signal to the indicator or controller. The Model 186 transformer can send this signal over a long distance, allowing remote monitoring of a current signal. All of the indicators and controllers can be easily scaled to display the correct current

being monitored. The model 186 is available from 0-1 mA up through 0-50 Amps.

186 Current Transformer



Power Supply

All units feature 120/220 VAC power supply. The 2800 series has an optional 5 VDC power supply, and the Mini-Max offers a choice of 12/24/48 VDC power supply. The Falcon indicators and Hawk controllers have optional 9-32 VDC power supply, and the Hawk/Hawk II controllers have an optional 24/48 VAC power supply.

Display Hold

Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the AC Voltage signal. The Hawk controller offers a special Peak Hold option for the AC TRMS measuring mode. The Peak Hold option will show the peak value, or spike, of the signal it is monitoring, then slowly decay to the current value of the signal.

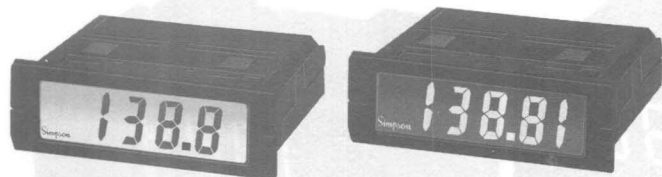
Relays, Analog and Digital Outputs

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in either the Hawk or Hawk II controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are standard programmable features to minimize relay chatter. The Hawk II has Analog output signals (4-20 mA, 0-1 V, and 0-10 V signals). The Hawk offers Analog or Digital output signals, such as RS 232/RS 422, as well as BCD output signals.



AC Voltage Indicators

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With a 3/64 DIN cutout and 60 mm depth, Mini-Max fits small spaces easily. Available in 3-1/2 or 4-1/2 digit LCD or optional negative image, red backlit display. A unique mounting bracket allows easy stacking of multiple units in one panel cutout, eliminating the need to tap multiple holes.

The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. The 4-1/2 digit indicator measures AC TRMS, while the 3-1/2 digit indicator measures Average Responding signals.



Falcon F35 low cost indicators can monitor 200 mV through 750 Volts. These units can monitor AC/AC TRMS signals, and offer broad range scaling to any engineering unit. The F35 can be modified in the field to accept a different range by moving selected jumpers on the main board. The decimal point can be changed in the field by moving jumpers on the display board, or from the screw terminals on back.



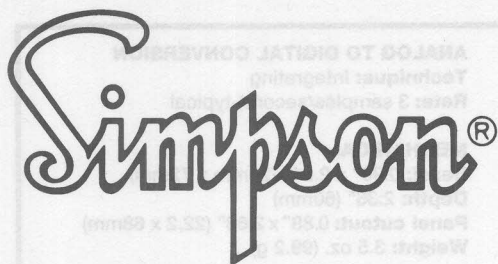
The Falcon F45 uses a precision microprocessor design to monitor either AC or AC TRMS signals. The high quality, 4-1/2 digit display can be protected by an optional NEMA 4 cover. Range selection and decimal point can be changed in the field by jumpers on the main board. In addition, the display can be easily scaled to any engineering unit you want.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include dual relays, Peak Hold for AC TRMS readings, and Analog/Digital output signals. Programming is easily accessed through the front panel buttons, with a password protection feature.



The Hawk II controller has a NEMA 4 rated front panel, screw terminals, and standard display hold. Options include Analog output signals, and up to two relays. The shallow depth allows easy installation in restricted panel spaces, and the unit can be powered by 24/48/120/220 VAC. User friendly programming allows you to lock out programming functions with a password protection feature.

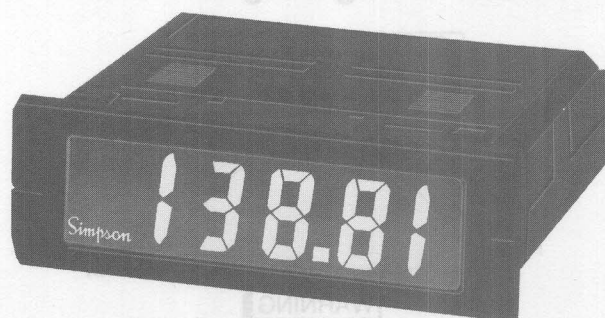


AC Voltage Indicators

MINI-MAX M235/M245 Series 3-1/2 & 4-1/2 Digit AC TRMS Indicators

- **Shallow Depth Indicator! Less Than 2.5" (60 mm) of Space Required Behind the Panel**
- **Fits 3/64 DIN Standard Cutout, 22.2mm x 68mm**
- **Stackable Mounting Bracket Included for Easy Installation**
- **3-1/2 or 4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Broad Range Display Scaling**
- **Optional Negative Image Bright Red Backlighting**
- **Standard Screw Terminals for Easy Installation**
- **5 Voltage Ranges: 200mV, 2V, 20V, 200V, 750V**
- **120/220 VAC, or 12/24/48 VDC Isolated Power**

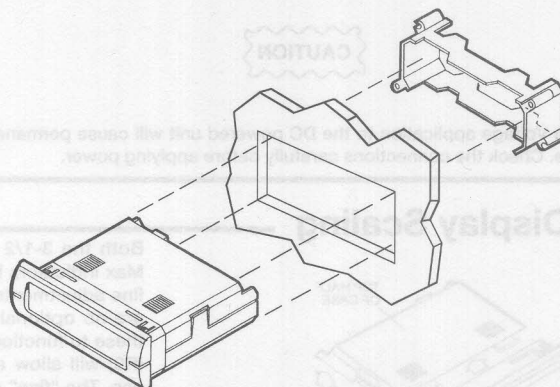
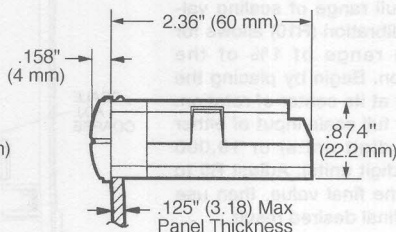
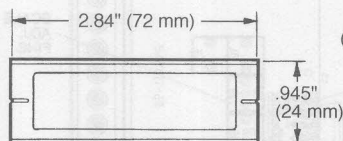
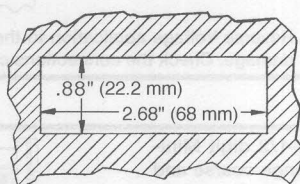
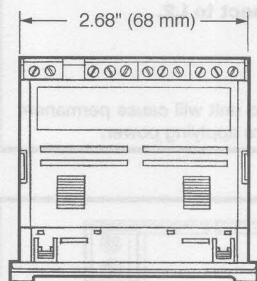
Simpson's new Mini-Max Voltage Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units offer choice of 3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, and scaling capabilities. Display hold is optionally



available for the 4-1/2 digit units. A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All Mini-Max units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.

Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 3 position programmable (3-1/2) or 4 position programmable (4-1/2)

Overrange indication: Most significant digit = "1"

Backlighting: Optional negative image, red LED backlighting

POWER REQUIREMENTS

AC Voltages: 120 (90-132) VAC @40-440 Hz
220 (180-264 Max.) VAC @40-440 Hz

DC Voltages: 12/24/48 VDC ($\pm 10\%$)

Power Consumption:

AC powered units: 3 VA min/12 VA max

DC powered units: 12 V @ 150 mA max;

24 V @ 80 mA max; 48 V @ 50 mA max.

Rated Circuit to Ground Voltage: 750 VRMS

ACCURACY as % of reading @ 25°C:

(@ > 5% of range) 40 Hz - 10 kHz

M235: $\pm(0.5\% + 5 \text{ counts})$

M245: $\pm(0.5\% + 50 \text{ counts})$

750 V range only: (40 Hz - 1 kHz)

M235: $\pm(0.5\% + 5 \text{ counts})$

M245: $\pm(0.5\% + 50 \text{ counts})$

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

AC Units: $\pm(0.05\% \text{ of Input } \pm 0.5 \text{ Digit})/^{\circ}\text{C}$

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/ 1 KV unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.95" x 2.84" (24mm x 72mm)

Depth: 2.36" (60mm)

Panel cutout: 0.88" x 2.68" (22.2 x 68mm)

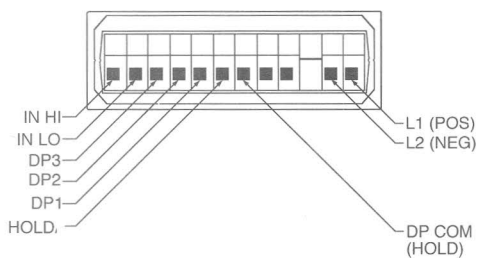
Weight: 3.5 oz. (99.2 g)

INPUTS: AC Voltage

Range	Resolution M235	Resolution M245	Input Impedance	Maximum Input
200 mV	100 μV	10 μV	>100M Ω	100 V
2 V	1 mV	100 μV	10M Ω	750 V
20 V	10 mV	1 mV	10M Ω	750 V
200 V	100 mV	10 mV	10M Ω	750 V
750 V	1 V	100 mV	10M Ω	750 V

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M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, or DP3) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

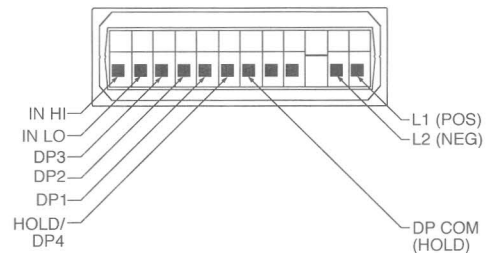
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

M245 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, DP3, or DP 4) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open). Hold is optional with the 4-1/2 digit Mini-Max, and when so equipped replaces DP4. Available through our factory or authorized modification centers.

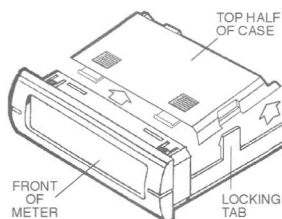
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

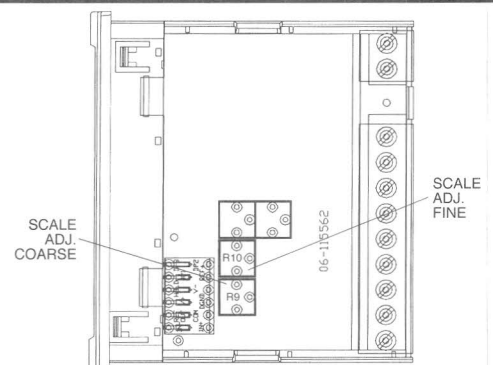
Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

Display Scaling



Using a screwdriver or thumbnail spread tab on each side of case to unlock top half. Lift rear of top half and slide away from front of meter.

Both the 3-1/2 and the 4-1/2 digit Mini-Max indicators have full-range coarse and fine adjustments for display scaling. There are no optional connections required for these to function. The "coarse" calibration (R9) will allow a full range of scaling values. The "fine" calibration (R10) allows for an approximate range of 1% of the "coarse" calibration. Begin by placing the "fine" adjust (R10) at its center of rotation. Then apply a near full scale input of either 1,900 (for 3-1/2 digit units) or 19,000 counts (for 4-1/2 digit units). Adjust R9 to be within 1% of the final value, then use R10 to obtain the final desired result.



Stacking Features

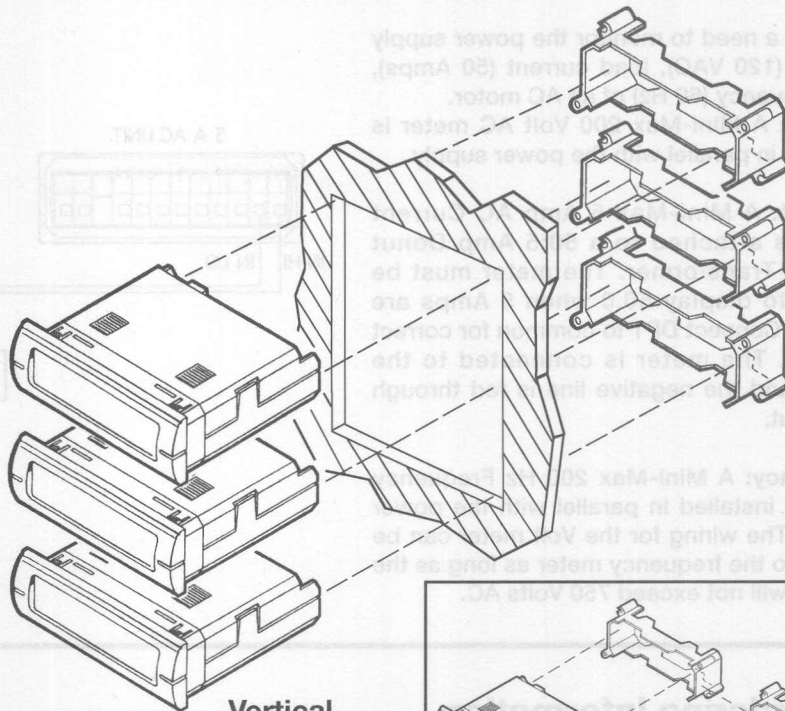
The mounting clips that come with every Mini-Max can be connected together. This allows multiple units to be mounted in one hole (no need to punch one hole per meter). Perfect alignment in the panel can be achieved, as only one hole is made.

Perfect for line monitoring applications, Mini-Max 3 Packs provide economical and reliable voltage, current, and frequency measurement capabilities in our most popular ranges. The power requirement is 120 VAC.

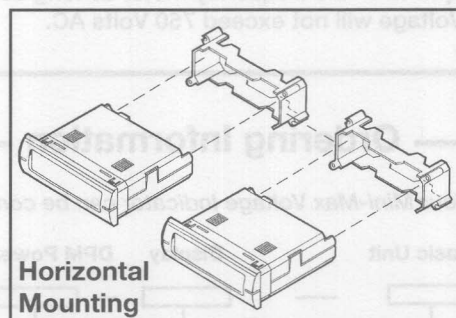
Mounting the three units is quick and easy. Install the bottom unit first. Place the next mounting clip on top of the previous clip, and slide the meter in place. Repeat this procedure for the top unit.

3-Pack Voltage/Frequency/Current Indicators

Type	Voltage	Current	Frequency	Backlight
M35031	200 V	5 A	199.9 Hz	None
M35131	200 V	5 A	199.9 Hz	Negative Red
M35032	750 V	5 A	1999 Hz	None
M35132	750 V	5 A	1999 Hz	Negative Red



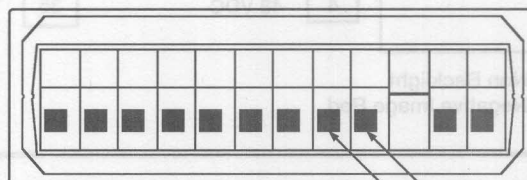
Vertical Mounting



Horizontal Mounting

Excitation Output

Excitation output is optionally available in the Mini-Max for powering external transmitters or transducers. Excitation is available from the EX POS and EX NEG terminals. This source is isolated from the measurement input as well as the input power circuits. The voltage available is 12 VDC with a maximum load current of 20 milliamps. This feature eliminates the need to mount an external DC power source for transducers or sensors used in your application.



CAUTION

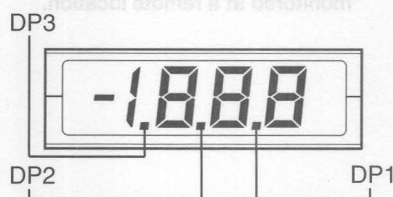
Do not exceed an excitation load current of 20 mA!

EX NEG
EX POS

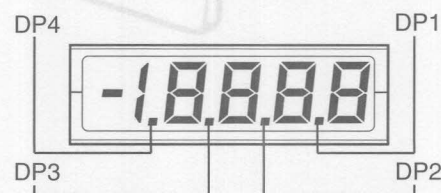
Backlight Option

Negative image, bright red, LED backlighting is available in the Mini-Max M235 and M245. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini-Max, so no additional external power supply is required.

Decimal Point 3-1/2



Decimal Point 4-1/2



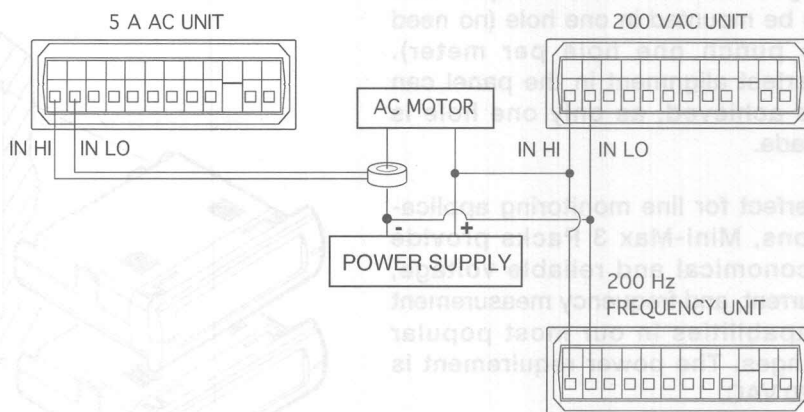
Application Example

There is a need to monitor the power supply voltage (120 VAC), load current (50 Amps), and frequency (60 Hz) of an AC motor.

Voltage: A Mini-Max 200 Volt AC meter is installed in parallel with the power supply.

Current: A Mini-Max 5 Amp AC Current meter is attached to a 50:5 Amp Donut Current Transformer. The meter must be scaled to display 50.0 when 5 Amps are applied. Connect DP1 to common for correct display. The meter is connected to the Donut, and the negative line is fed through the donut.

Frequency: A Mini-Max 200 Hz Frequency meter is installed in parallel with the power supply. The wiring for the Volt meter can be split to to the frequency meter as long as the Voltage will not exceed 750 Volts AC.



Ordering Information

Your Mini-Max Voltage Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Excitation Output
M235 M245	0 1 2 3 4	0 120 VAC 1 220 VAC 2 12 VDC 3 24 VDC 4 48 VDC	31 200mV 32 2 V 33 20 V 34 200 V 35 750 V	0 None 1 12 VDC
0 Non Backlight 1 Negative Image Red				

Safety Symbols

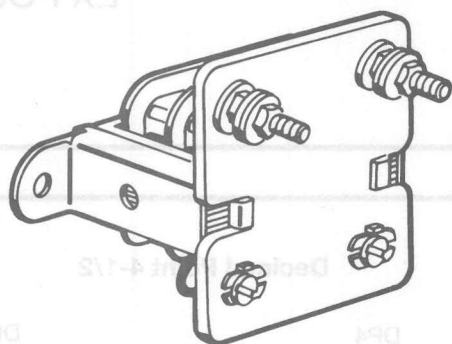
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

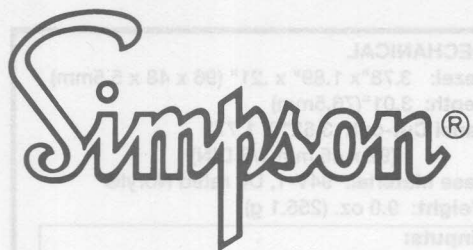
Accessories



Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1999 Amps) is to be monitored at a remote location.

Range	VA	Cat. Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



AC Voltage Indicators

Falcon F35 Series AC/AC TRMS 3-1/2 Digit

- Full 3-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200mV, 2V, 20V, 200V, 750V
- Jumper Selectable Decimal Point
- Average Responding and TRMS Measurement Ranges
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply

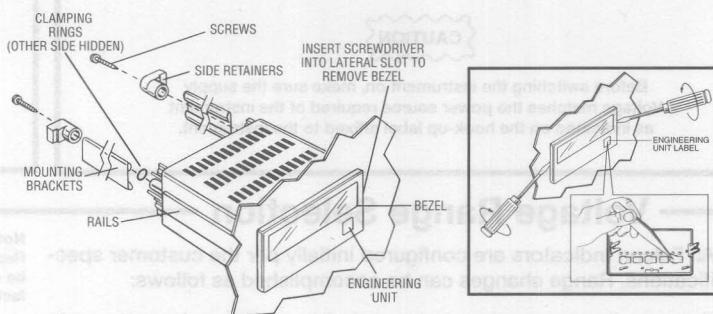
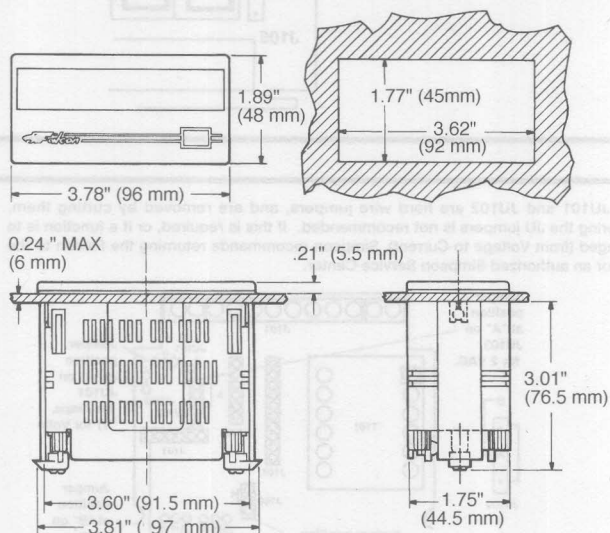
The Falcon Series digital indicators are premium quality 1/8 DIN meters for industrial applications with display scaling capability. All Falcon units feature jumper selectable decimal point (internal and on the connector for remote decimal point), providing wide application flexibility. In addition, signal input ranges are easy to change with jumpers on the main board. The Falcon has a 0.56" bright red LED display for high

visibility and an optional NEMA 4 cover to protect the display in washdown environments. Compactly designed for applications requiring minimal rear panel depth, the Falcon fits a standard 1/8 DIN panel cutout (92mm x 45mm) and requires only 3.01" behind the panel. A screw terminal connector is a standard feature for easy wiring of the power supply and signal input connections.



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Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove the screws, side retainers, and mounting brackets from the rails as shown above. Position the Falcon into the cutout. From the rear of the panel, slide the panel mounting brackets back onto the rails until the brackets are flush against the back of the panel. Replace the side retainers and screws.

Engineering Label Placement

If replacement of the engineering unit label is required, insert a small screwdriver into the lateral slot on side of bezel and gently turn the screwdriver until the bezel snaps away from the case. Use tweezers to remove and replace the engineering unit label. Gently snap the bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED
Height: 0.56" (14.2mm)
Decimal Point: 3 position programmable, internally or on the terminal block.
Overrange indication: 3 least significant digits blank, above 1999 counts.
Polarity: Automatic, with "-" indication, "+" indication implied.
Span: User adjustable up to 1999 counts.

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$
DC Voltages: 9-32 VDC
Power Consumption: 3VA

ACCURACY @25° C

$\pm 1\%$ of reading ± 5 counts (45 Hz - 1 kHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -10 to 60°C
Relative Humidity: 0 to 85% non-condensing
Temperature Coefficient:
($\pm 0.1\%$ of input ± 0.5 count)/°C
Warm-up Time: Less than 15 minutes
Response Time: Less than 3 seconds

NOISE REJECTION

NMRR: 50 dB, 50/60 Hz
CMRR: (w/1K Ω unbalanced @ 60 Hz):
90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration
Rate: 3 samples per second, nominal

MECHANICAL

Bezel: 3.78"x 1.89" x .21" (96 x 48 x 5.5mm)
Depth: 3.01" (76.5mm)
Panel Cut-out: 3.62" X 1.77"
(92 x 45 mm 1/8 DIN)
Case Material: 94V-1, UL rated Noryl®
Weight: 9.0 oz. (255.1 g)

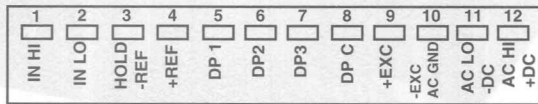
Inputs:

AC/AC TRMS Voltage

Input Range	Display Resolution	Input Impedance	Max. Overload
200 mV	100 μ V	≥ 100 M Ω	50 V
2 V	1 mV	1 M Ω	100 V
20 V	10 mV	10 M Ω	100 V
200 V	100 mV	10 M Ω	250 V
750 V	1 V	10 M Ω	750 V

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Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. IN HI is terminal #1, IN LO is terminal #2.

Supply Power: Connect the supply power to terminals #11 and #12. Note that if AC power is supplied, terminal #10 is for AC Ground, terminal #11 is for AC Neutral, and terminal #12 is for AC Hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch can be used to make the connection. To activate the display hold, short terminal blocks #3 and #4 (Hold Ref and +Ref).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

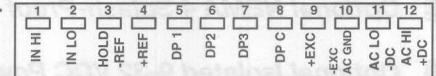
CAUTION

Before switching the instrument on, make sure the supply Voltage matches the power source required of the instrument as indicated on the hook-up label affixed to the instrument.

Decimal Point Selection

From terminal block: The decimal point can be set from the rear screw terminal block by connecting the appropriate decimal point (DP 1, 2, 3,) to the DP C terminal. The J105 jumper must be in the D position (see diagram under "From front panel").

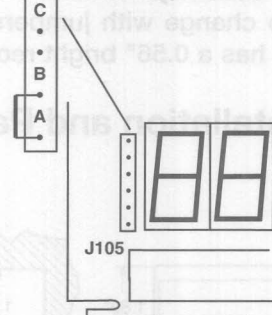
Decimal Point	Connect
1.999	DP C to DP1
19.99	DP C to DP2
199.9	DP C to DP3
1999	No Decimal



From front panel: The decimal point can also be selected by removing the front bezel from the meter. Move the push-on jumper J105 across the correct letter.

Decimal Point	Jumper Position at J105
1.999	A
19.99	B
199.9	C
1999	D

Exploded view showing jumper position "A" at J105 for decimal point 1.999



Voltage Range Selection

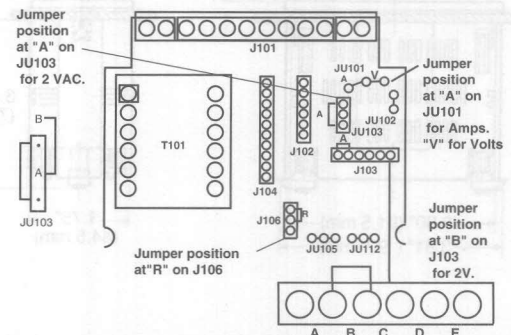
All Falcon Indicators are configured initially per the customer specifications. Range changes can be accomplished as follows:

Remove the screws, brackets, and side retainers from the unit. Next, remove the O-rings from the two rear posts where the brackets are screwed in. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

If a new range is selected, the calibration procedure must also be performed. See the chart below for jumper locations.

Input Range	J103	J106	JU101	JU102	JU103
200 mV	C	R	V	YES	B
2 V	B	R	V	NO	A
20 V	B	R	V	NO	B
200 V	D	R	V	NO	B
750 V	E	R	V	NO	B

Note: JU101 and JU102 are hard wire jumpers, and are removed by cutting them. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed (from Voltage to Current), Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center.

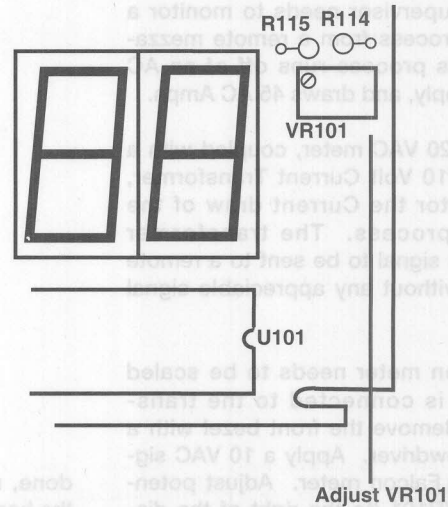


Display Scaling

The Falcon can be easily scaled to indicate any engineering unit. This allows the unit to take in a specified input signal and display a different engineering unit.

For example, if a 200 V load is being monitored, and you need the meter to display 0-150%:

- 1) Remove the front bezel with a small screwdriver.
- 2) Apply the signal input for the meter (199.9 V signal).
- 3) Adjust the potentiometer VR101 located on the right side of the display board to display the maximum reading desired (150.0%). The maximum value is adjustable from 1200 - 1999; for other ranges, consult the factory.
- 4) Remove the old Engineering unit label, and replace it with the unit you need. Replace the bezel carefully.



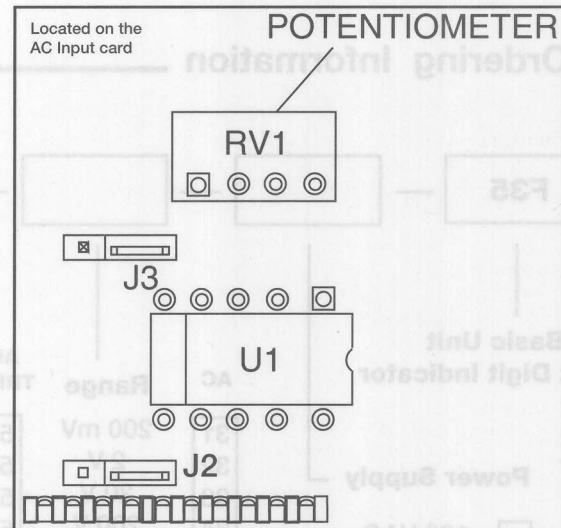
Calibration

WARNING

The following procedure requires opening the unit and removing the top cover with the power ON. Use insulated screwdriver and extreme caution when making these adjustments. It is advisable to have an Authorized Service Center perform this operation, or return the Falcon to the Factory.

The Falcon is calibrated at the factory per order. If you change the range, and have moved the jumpers, your Falcon will need to be recalibrated.

- 1) Remove the bezel with a small screwdriver, and remove O-rings from rear of unit and take off top of unit.
- 2) Short input terminals #1 and #2 (IN HI and IN LO) and adjust potentiometer RV1 on AC Input card until display reads 0±1 count.
- 3) Apply an input signal to terminals #1 and #2, and adjust potentiometer VR101 until the display indicates the value of the signal or desired display value. See diagram in Display Scaling.
- 4) Re-assemble the meter and install it in your panel.

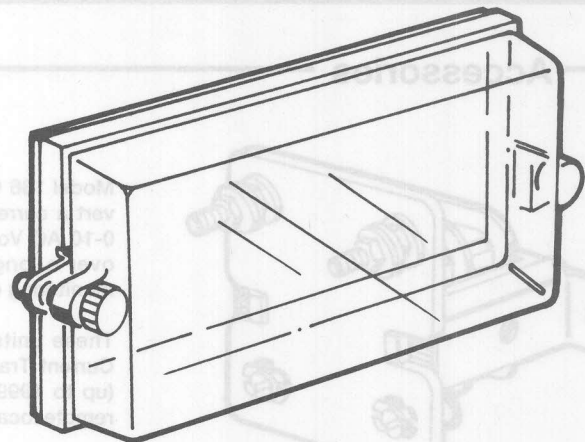


NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Falcon series indicators. This cover will help protect the meter in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Falcon is exposed, and can be removed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the Falcon through the gasket and install the meter into the panel. Then attach the front part of the NEMA 4 cover. Screw the cover on tightly, compressing the gasket about 75%.



Application Example

A Plant Supervisor needs to monitor a welding process from a remote mezzanine. This process runs off of an AC power supply, and draws 45 AC Amps.

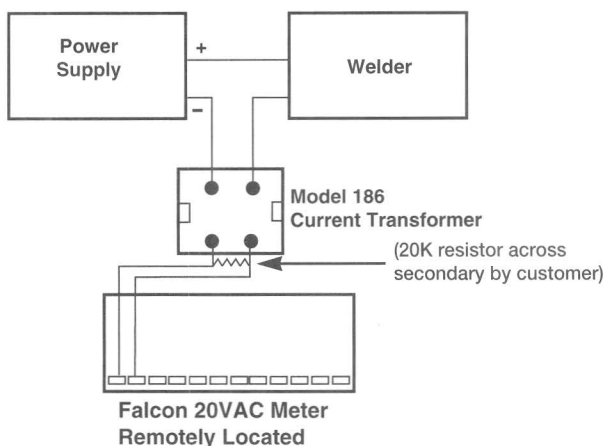
A Falcon 20 VAC meter, coupled with a 100 Amp/10 Volt Current Transformer, can monitor the Current draw of the welding process. The transformer allows the signal to be sent to a remote location without any appreciable signal loss.

The Falcon meter needs to be scaled before it is connected to the transformer. Remove the front bezel with a small screwdriver. Apply a 10 VAC signal to the Falcon meter. Adjust potentiometer VR101 (to the right of the display) until the meter indicates 100 (Amps), which is the full scale output of the Current Transformer. Once this is

done, remove the signal input and put the bezel back on the Falcon.

The Current Transformer is installed in series between the power supply and

the welding process. The Falcon AC Volt meter is connected to the transformer. The Falcon can be installed in the mezzanine, remotely located from the transformer (and the process).



Ordering Information

F35				
Basic Unit 3-1/2 Digit Indicator				
Power Supply				
1	120 VAC	31	200 mV	51
2	220 VAC	32	2 V	52
3	9-32 VDC	33	20 V	53
		34	200 V	54
		35	750 V	55
		AC	Range	AC TRMS
				Excitation
				0 None
				Nema 4 cover Catalog # 45003

Safety Symbols

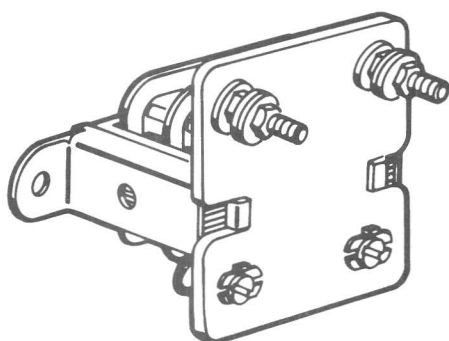
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1999 Amps) is to be monitored at a remote location.

Range	VA	Cat. Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



AC Voltage Indicators

Falcon F45 Series AC/AC TRMS 4-1/2 Digit

- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to Any Engineering Units
- Precision Microprocessor Design
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200mV, 2V, 20V, 200V, 750V
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply

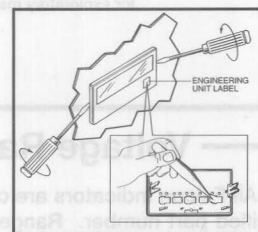
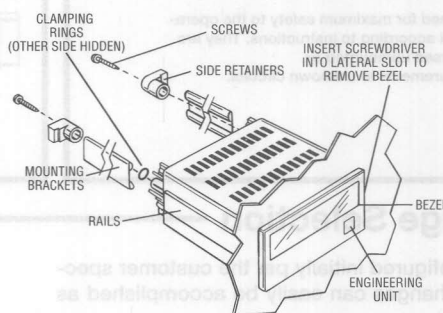
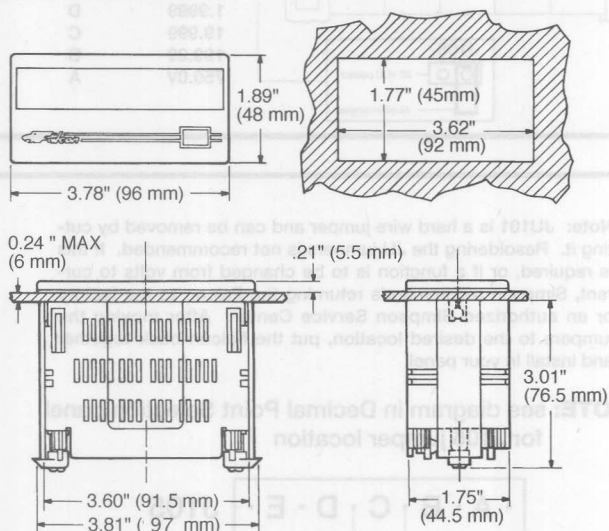


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The Falcon Series digital indicators are premium quality 1/8 DIN meters for rough industrial applications with multi-function and range capability. All AC and AC TRMS Voltage units feature display scaling and selectable decimal point providing the ultimate in application flexibility. The meter is designed to operate from either 120 VAC, 220 VAC (50 to 400 Hz), or 9

to 32 VDC. For high visibility, the Falcon has a 4-1/2 digit 0.56" bright red LED display and uses precision circuitry to provide a basic accuracy of $\pm 0.5\%$ of reading ± 35 digits for ACV inputs. A screw type terminal block is provided standard for easy installation and a NEMA 4 splash-proof lens cover is available for wash down areas.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 4 position programmable internally or at terminal block J112.

Overrange indication: 1 and 4 LSD blank with polarity sign.

Polarity: Automatic, with "-" indication, "+" indication implied.

Span: User selectable-19999 to +32563 with a scale factor 6 maximum.

Scale Factor:

$$M = \frac{\text{Hi-Lo}}{\text{HiE-LoE}}$$

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC; 9V -1% and 32+1%

Power Consumption: 2VA

ACCURACY @25° C

$\pm 0.5\%$ of reading ± 35 counts (45Hz-1kHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

($\pm 0.05\%$ of input ± 0.5 digit)/°C

Warm-up Time: Less than 15 minutes

Response Time: Less than 3 seconds

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/1k Ω unbalanced @ 60 Hz):

90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Rate: 2.5 samples per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .22" (96 x 48 x 5.5mm)

Depth: 3.01" (76.5mm)

Panel Cut-out: 3.6" X 1.8" (92 x 45 mm)

Case Material: 94V-1, UL rated noryl

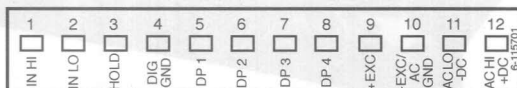
Weight: 9.0 oz. (255.1 g)

AC/AC TRMS Voltage

Input Range	Display Resolution	Input Impedance	Max. Overload
200 mV	10 μ V	≥ 100 M Ω	50 V
2 V	100 μ V	1 M Ω	100 V
20 V	1 mV	1 M Ω	100 V
200 V	10 mV	1 M Ω	250 V
750 V	100 mV	1 M Ω	750 V

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Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. These are terminals #1 and #2.

Supply Power: Connect the power to terminal #10 for ground and #11 and #12 for neutral and hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Note: AC Ground terminal #10 is used with AC inputs only.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch or computer, etc. can be used to activate this feature. To install this feature, short circuit terminal block J112, Pins 3 and 4 (Hold and DIG GND).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

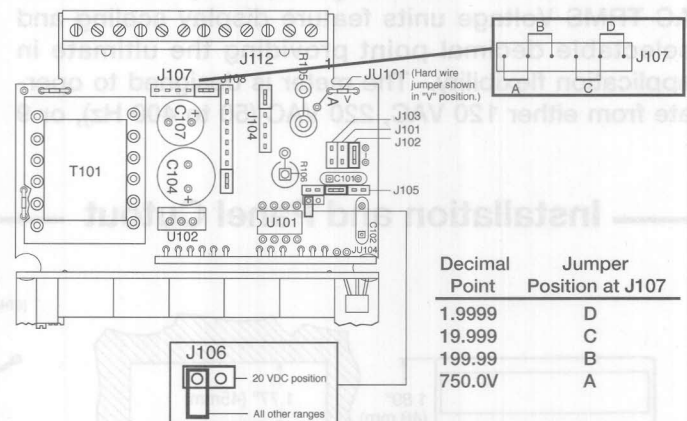
Decimal Point Selection

From terminal block J112: The decimal point can be set from the rear screw terminal block J112. Connect the appropriate DP point (DP 1, 2, 3, 4) to the DIG GND terminal. Internal jumper (J107) should be removed and stored on the last contact of J107.

Decimal Point	Connect
1.9999	DIG GND to DP1
19.999	DIG GND to DP2
199.99	DIG GND to DP3
750.0	DIG GND to DP4



From main board: The decimal point can also be selected by removing the top half of meter case. Move the push-on jumper J107 across the correct letter.



Decimal Point	Jumper Position at J107
1.9999	D
19.999	C
199.99	B
750.0V	A

Voltage Range Selection

All Falcon Indicators are configured initially per the customer specified part number. Range changes can easily be accomplished as follows:

Remove the brackets and sliding rails from the unit. Next, remove the O-rings on the rear bracket mounts. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

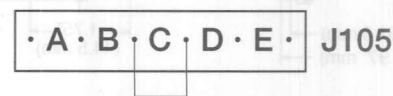
Note: If a new range is selected, the calibration procedure must also be performed. Only perform this section if a different function or range is required.

Input	J105	J106	J101	J102	J103	JU101*
Range	PJ	PJ	PJ	PJ	PJ	Jumper Position
200 mV	C	NO	NO	YES	NO	V
2V	B	NO	NO	NO	YES	V
20V	D	NO	NO	NO	YES	V
200V	E	NO	NO	NO	YES	V

* 750 Volt range may be configured upon order by factory or authorized Simpson Modification Center

Note: JU101 is a hard wire jumper and can be removed by cutting it. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed from volts to current, Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center. After moving the jumpers to the desired location, put the Falcon back together and install in your panel.

NOTE: see diagram in Decimal Point Selection panel for J106 jumper location



Example: 200 mV input

Display Scaling

The Falcon display can be easily scaled to display any engineering unit. Remove the front bezel with a small screwdriver. The scaling procedure is performed at terminal J1 located on the left side of the display board. There are four sets of pins on J1 as shown in the drawing. Each group of pins programs a particular parameter of the scaling procedure when a push-on jumper (supplied with Falcon) is momentarily placed across a set of pins.

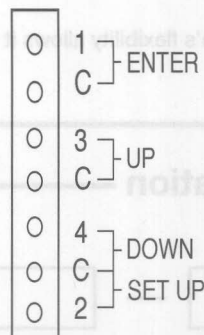
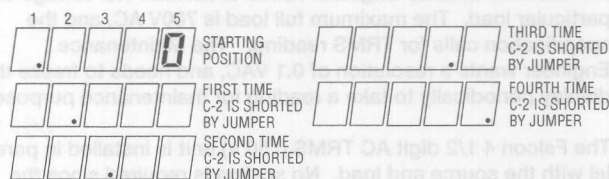
Before scaling the parameters, begin by disconnecting power to the Falcon. Place push-on jumper onto "SETUP" pins C and 2. Then apply power. At this point the Falcon performs a self test (scrolls LED display showing numerals 1 through 5) and then indicates LoE allowing you to enter the low electrical input value.

The scaling parameters for electrical low input value(LoE), electrical high input value(HiE), display low value(Lo), and display high value (Hi) are performed in the same manner as follows:

Remove push-on jumper from C-2 and then replace. Numeral zero or digit of LoE value (set at the factory) and flashing decimal point are displayed at starting LED position. The digit to be entered is always to the left of the flashing decimal point. The flashing decimal point is moved one position each time the push-on jumper is momentarily placed across "SETUP" pins C and 2. Change the value at the LED position chosen by momentarily placing jumper across "UP" pins C and 3. This will increase the value by 1 for each repetition. Repeat jumper placement until desired value is displayed. To decrease a display value, momentarily place jumper across "down" pins C and 4.

After the desired numeric value is obtained it is necessary to remove the jumper and momentarily place it across the "ENTER" pins C and 1 to store value in memory. LED display indicates next parameter. Repeat this procedure through each parameter.

After programming the last parameter (Hi) of the scaling procedure, LED will display "END" and then indicate scaled value of electrical input to the meter. The unit is now in "run" mode.



Enter-Saves digits displayed and advances to next scaling parameter when jumper makes momentary contact with pins 1 and C.

UP-Changes digit displayed to next ascending value when jumper makes momentary contact with pins 3 and C.

DOWN-Changes digit displayed to next descending value when jumper makes momentary contact with pins 4 and C.

SETUP-Starts scaling cycle of the four scaling parameters (LoE, HiE, Lo and Hi) and selects decimal point on display when jumper makes momentary contact with pins 2 and C.

Typical Scaling Application

50mV Shunt; NOTE: 200mV range is used

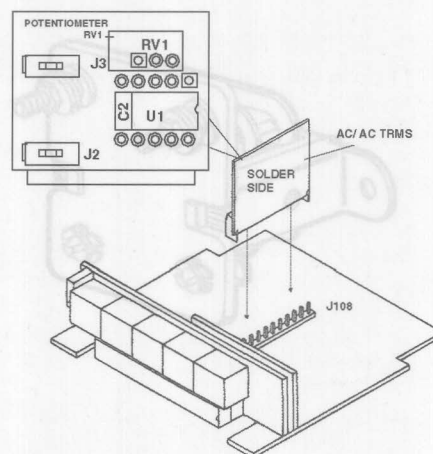
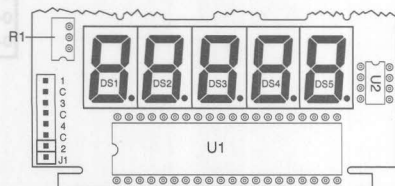
Electrical Characteristics Falcon LED Display

Current: 100 Amps	LoE: 0	Lo: 0
Voltage Drop: 50mV	HiE: 50.00	Hi: 100.00

Calibration

The unit is calibrated at the factory per order. If you selected another range, and moved the jumpers, your Falcon will need to be recalibrated. If parameters (HiE, etc.) are changed, scaling must be performed prior to calibration.

- 1) Place jumper across J112 screw terminal block contacts 1 (IN HI) and 2 (IN LO).
- 2) Adjust potentiometer RV1 on the AC printed circuit board (plugged into main board) until LED display reads ± 1 count. Replace jumper connected to J112 pins 1 and 2 with AC input signal for full scale value.
- 3) Adjust the potentiometer R1 located on the upper left-hand side of the display board until display shows the full scale voltage.
- 4) Replace bezel carefully

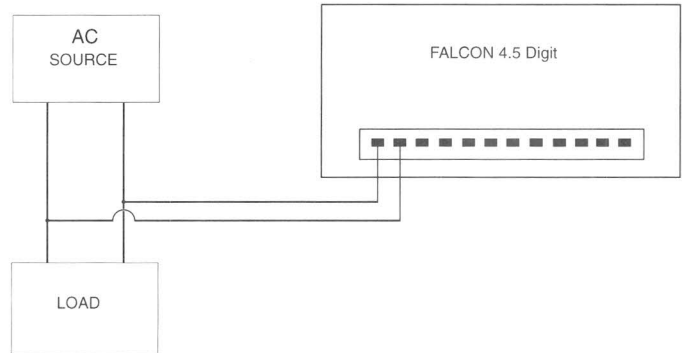


Application Example

A Plant Maintenance Engineer needs to monitor AC Voltage of a particular load. The maximum full load is 700V AC, and the specification calls for TRMS reading. The Maintenance Engineer wants a resolution of 0.1 VAC, and needs to freeze the display periodically to take a reading for maintenance purposes.

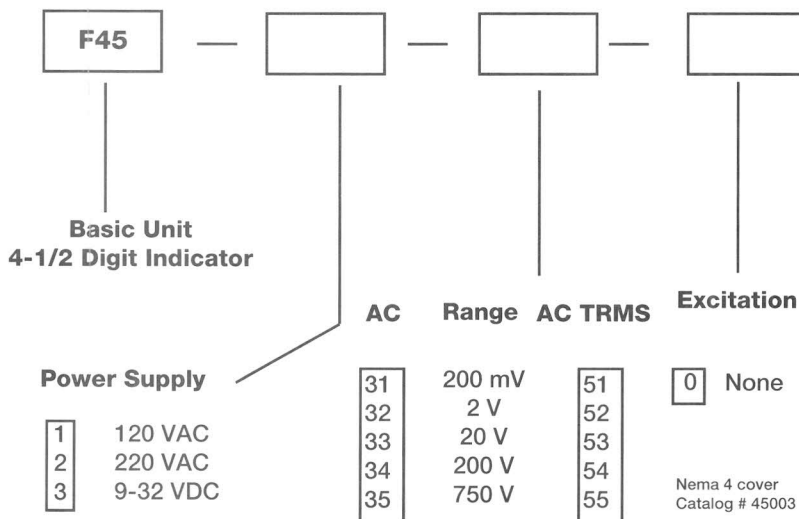
The Falcon 4 1/2 digit AC TRMS (750 V) unit is installed in parallel with the source and load. No scaling is required since the electrical input range of the meter is the same as the displayed range, and it has a 0.1 Volt resolution. The Falcon has a standard Display Hold feature, that can be wired to a switch the operator can use to "hold" the display.

If the application changes, the Falcon's flexibility allows it to be scaled and calibrated accordingly.



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Ordering Information



Safety Symbols

WARNING

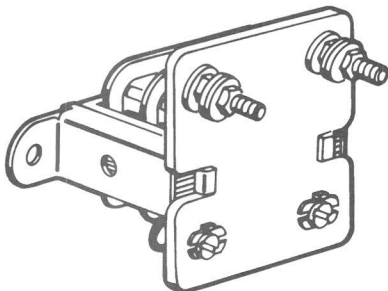
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

Model 186 Current Transformer



Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1999 Amps) is to be monitored at a remote location.

Ordering Information

Range	VA	Cat. Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



AC Voltage Indicators

2844 & 2845 Series TRMS 4-1/2 Digit

- **4 Voltage Ranges Available: 200 mV, 2 V, 20 V, 200 V**
- **True RMS Responding and Reading**
- **Jumper Selectable Decimal Point**
- **Input/Output Edge Connector**
- **4-1/2 Digit, 0.56" Red LED Display**
- **Model 2844 Requires 117 VAC Power Supply**
- **Model 2845 Requires 5 VDC Power Supply**
- **Optional 234 VAC Power Supply**
- **Optional Display Hold**
- **Additional Rear Terminal Connector Available**
- **Optional Cutout Adapters**

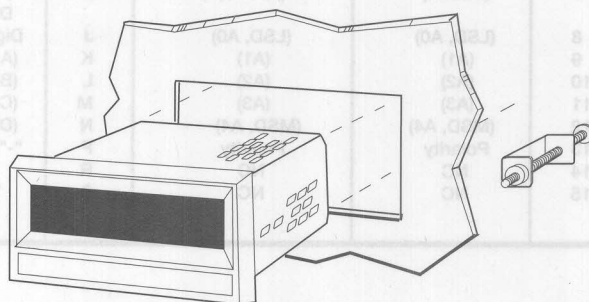
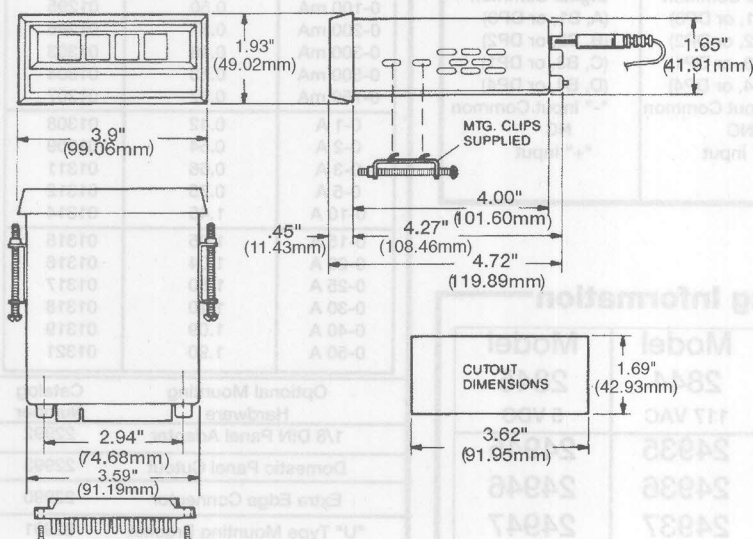


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Simpson's 2844 and 2845 Series meters offer high accuracy with True RMS measurement. Model 2844 requires a 117 VAC input at 50-400 Hz, and model 2845 requires a 5 VDC input at 500 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 4-1/2 digit display is easily readable from a

distance. Panel adapters are available for 1/8 DIN panel cutouts, and for domestic sized cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied).

Installation and Panel Cutout



Mounting Instructions

The 2844 and 2845 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 3 segment, red LED
Height: 0.56" (14.2mm)
Decimal point: With jumper selectable
Overrange indication: All digits blink "0"

POWER REQUIREMENTS

AC Voltages: 117 V, $\pm 10\%$, 50 Hz to 400 Hz, 6VA
 234 V, $\pm 10\%$, 50 Hz to 400 Hz, 6VA
DC Voltages: 5 V, $\pm 5\%$ at 500 mA
Rated Circuit to Ground Voltage: 250 VDC
 (Model 2844) or 5 VDC (Model 2845)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$

$\pm(0.5\%$ of input ± 35 counts) 45 Hz to 1KHz

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -40 to 60°C
Relative Humidity: 0 to 85%, non-condensing
Warmup time: 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope
Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)
Depth: 4.27" (109mm)
Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)
Weight: 12.5 oz. (354.3 g)

INPUTS

AC TRMS Voltage

Range	Display Resolution	Input Resistance
200 mV	10 μV	100 M Ω
2 V	100 μV	100 M Ω
20 V	1 mV	10 M Ω
200 V	10 mV	10 M Ω

Overload Protection = 250 V on all Ranges

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

By shorting Pin H to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. If the Display Hold option is requested from our factory or an Authorized Service Center, the BCD outputs are disconnected.

Supply Power

If the unit is powered by VAC, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin #1 and A. The "+" VDC is connected to Pin #4.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Jumper Selectable Decimal Point

The unit is shipped with the decimal point based on the range selected. Remote Decimal Point selection is available from our factory or an Authorized Service Center.

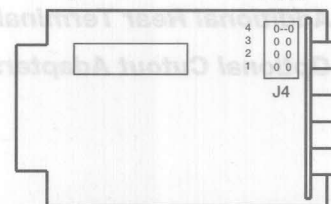
BCD Outputs

The unit is shipped configured with BCD outputs. If Remote Decimal Point is chosen, the BCD output must be disconnected. The unit uses the same connector points for both. Note that this holds true for the Display Hold option also.

Jumper Decimal Point

The Decimal Point can be changed by moving Jumper J4 inside the unit. The meter must be disassembled, exposing the main board. The Edge Connector should be removed first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
4	1000.0
1	100.00
2	10.000
3	1.0000



Accessories

Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal. These transformers must be used with an AC Volt meter.

2844 and 2845 meters are not field scaleable; please consult the factory or a service center.

Range	VA	Catalog Number
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307
0-1 A	0.42	01308
0-2 A	0.54	01309
0-3 A	0.66	01311
0-5 A	0.75	01312
0-10 A	1.45	01314
0-15 A	1.05	01315
0-20 A	1.04	01316
0-25 A	1.50	01317
0-30 A	1.10	01318
0-40 A	1.09	01319
0-50 A	1.90	01321

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout	22993
Extra Edge Connector	22990
"U" Type Mounting Bracket	22991

Please see the Accessory section for full details on the Mounting Hardware

Pin Number	2844 Circuit	2845 Circuit	Pin Number	2844 Circuit	2845 Circuit
1	3rd wire GND	5VDC Return	A	3rd wire GND	5 VDC Return
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	(Strobe)	(Strobe)	H	(Hold/Remote DP Common)	(Hold/Remote DP Common)
8	(LSD, A0)	(LSD, A0)	J	Digital Common	Digital Common
9	(A1)	(A1)	K	(A, B1, or DP3)	(A, B1, or DP3)
10	(A2)	(A2)	L	(B, B2, or DP2)	(B, B2, or DP2)
11	(A3)	(A3)	M	(C, B3, or DP1)	(C, B3, or DP1)
12	(MSD, A4)	(MSD, A4)	N	(D, B4, or DP4)	(D, B4, or DP4)
13	Polarity	Polarity	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

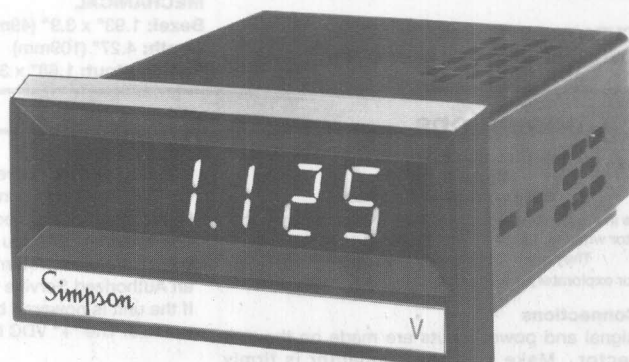
Range	Model 2844	Model 2845
	117 VAC	5 VDC
200 mV	24935	24945
2 V	24936	24946
20 V	24937	24947
200 V	24938	24948



AC Voltage Indicators

2869 & 2870 Series 3-1/2 Digit

- 4 Voltage Ranges Available: 200 mV, 2 V, 20 V, 200 V
- Jumper Selectable Decimal Point
- Input/Output Edge Connector
- 3-1/2 Digit, 0.56" Orange LED Display
- Model 2869 Requires 117 VAC Power Supply
- Model 2870 Requires 5 VDC Power Supply
- Optional 234 VAC Power Supply
- Additional Rear Terminal Connector Available
- Optional Cutout Adapters
- Optional "U" Shaped Mounting Bracket

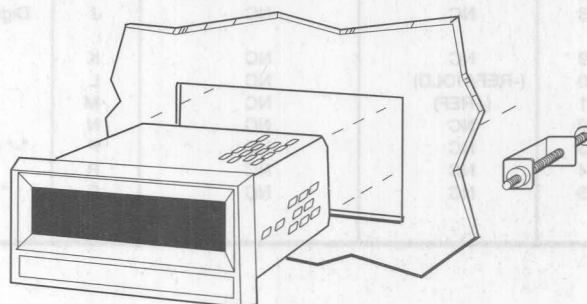
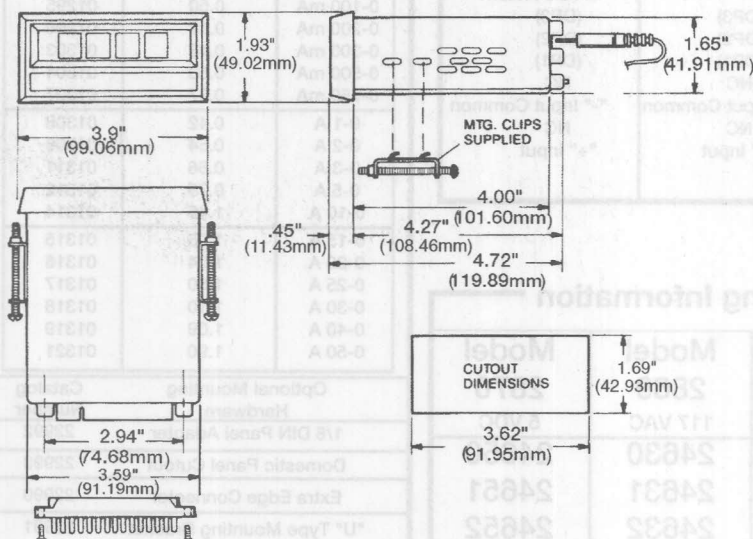


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3

Simpson's 2869 and 2870 Series meters offer high accuracy and a two piece edge connector for easy wiring of the input signal. Additional two piece connectors are available from your Authorized Simpson Distributor. Model 2869 requires a 117 VAC input at 50-400 Hz, and model 2870 requires a 5 VDC input at 200 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large Orange 3-1/2 digit display is easily readable from a distance (about 25 feet),

and in low to moderate light conditions. Panel cutout adapters are available for 1/8 DIN panel cutouts, and for domestic sized cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. The Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied). The 2869 / 2870 Series has a jumper selectable decimal point, which can be remotely changed (if installed by an Authorized Service Center).

Installation and Panel Cutout



Mounting Instructions

The 2869 and 2870 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 7 segment, orange LED
Height: 0.56" (14.2mm)
Decimal point: Jumper selectable
Overrange indication: All digits blink "0"

POWER REQUIREMENTS

AC Voltages: 117 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA
DC Voltages: 5 V, $\pm 5\%$ at 200 mA
Rated Circuit to Ground Voltage: 250 VDC
 (Model 2869) or -4.06 to +4.5 VDC (Model 2870)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$

$\pm(1.0\%$ of input +5 counts) 45 Hz to 1KHz

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -40 to 60 °C
Relative Humidity: 0 to 85%, non-condensing
Temp. Coefficient: $\pm(0.1\%$ of input) per °C
Warmup time: 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope
Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)
Depth: 4.27" (109mm)
Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: AC Voltage

Range	Display Resolution	Input Resistance
200 mV	100 μV	$\geq 100 \text{ M}\Omega$
2 V	1 mV	10 $\text{M}\Omega$
20 V	10 mV	10 $\text{M}\Omega$
200 V	100 mV	10 $\text{M}\Omega$

Overload Protection = 250 VRMS
on all ranges.

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

By shorting Pin 10 to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This optional feature is available from the factory or from one of our Authorized Service Centers.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin J. The "+" VDC is connected to Pin #4.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Remote Decimal Point

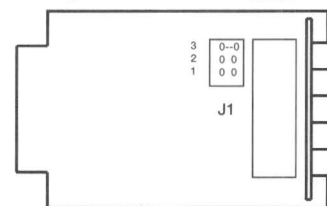
This option allows you to remotely select different decimal points without opening the meter to make the changes. This option can be installed by the factory or one of our Authorized Service Centers. Remote Decimal point uses the same terminal points as Display Hold, eliminating the Display Hold capability if specified.

Jumper Decimal Point

The Decimal Point can be changed by moving Jumper J1 inside the unit. The meter must be disassembled, exposing the main board. The Edge Connector should be removed first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position Decimal Point

1	100.0
2	10.00
3	1.000



Accessories

Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal. These transformers must be used with an AC Volt meter.

2844 and 2845 meters are not field scaleable; please consult the factory or a service center.

Range	VA	Catalog Number
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307
0-1 A	0.42	01308
0-2 A	0.54	01309
0-3 A	0.66	01311
0-5 A	0.75	01312
0-10 A	1.45	01314
0-15 A	1.05	01315
0-20 A	1.04	01316
0-25 A	1.50	01317
0-30 A	1.10	01318
0-40 A	1.09	01319
0-50 A	1.90	01321

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout	22993
Extra Edge Connector	22990
"U" Type Mounting Bracket	22991

Please see the Accessory section for full details on the Mounting Hardware

Safety Symbols

WARNING

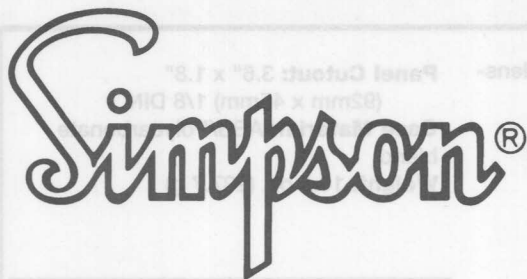
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model 2869	Model 2870
	117 VAC	5 VDC
200 mV	24630	24650
2 V	24631	24651
20 V	24632	24652
200 V	24633	24653



AC Voltage Controllers

HAWK II

Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- Easily Programmed from the Front Panel
- User Friendly Software Functions Include:
Password
Display Scaling
Decimal Point Selection
Zero, One, or Two Setpoints
Peak-Valley Values
Time Delay & Hysteresis
- Screw Terminal Connector for Easy Installation
- 1/8 DIN, Shallow Depth case,
3.5" (89mm) for Restricted Space Behind Panel
- Nema 4 / IP 65 Front Panel
- 5 AC Voltage Ranges: 200 mV, 2 V, 20 V, 200 V, 690 V
- Optional 5 Amp Relay Outputs,
Excitation Outputs, and Analog Outputs.



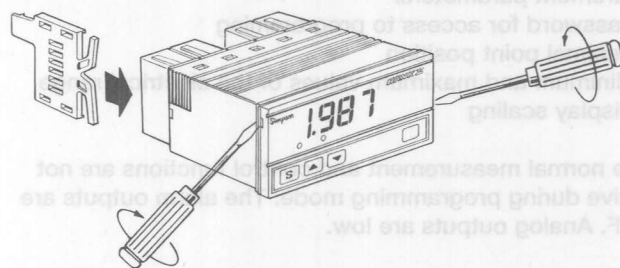
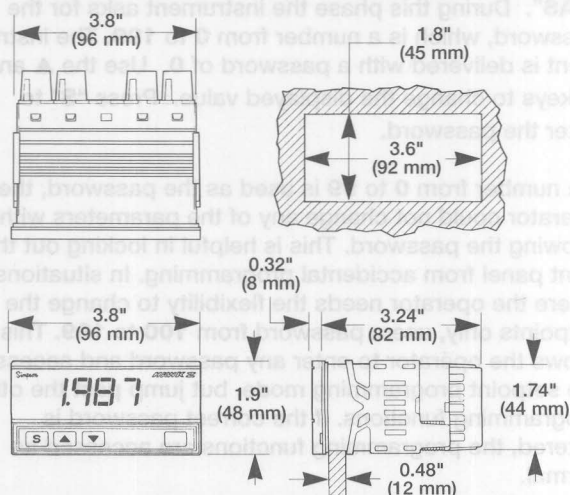
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature. Depending on the password value chosen the cus-

tommer may lock out all changes, or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 3 position software programmable from front panel.

Overrange: Display reads "EE".

Underrange: Display reads "-EE".

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230 VAC, $\pm 10\%$

DC Voltages: Future Availability

Power Consumption: 6 VA

ACCURACY:

$\pm 0.3\% \pm 3$ digits

ENVIRONMENTAL

Operating Temperature: 0°C to $+50^{\circ}\text{C}$

Storage Temperature: -10°C to $+60^{\circ}\text{C}$

Relative Humidity: $<90\%$ non-condensing

Ambient Temperature: 23°C

Temperature Coefficient (per $^{\circ}\text{C}$):

± 150 ppm/ $^{\circ}\text{C}$

± 0.2 dgt/ $^{\circ}\text{C}$

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 V

CMRR: 100 dB, GR = 1 KV

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32"

(96mm x 48mm x 8.1 mm)

Depth: 3.56" (90mm)

Panel Cutout: 3.6" x 1.8"

(92mm x 45mm) 1/8 DIN

Case Material: ABS/Polycarbonate blend

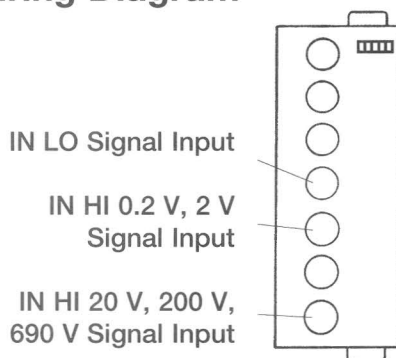
Weight: 10.5 oz. (297.7 g)

Inputs:

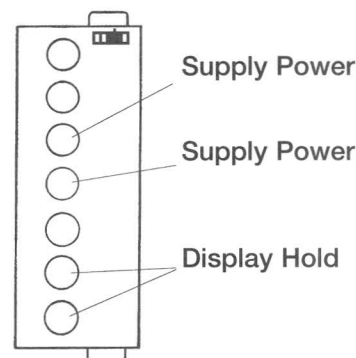
AC Voltage

Input Range	Display Resolution	Input Impedance	Max. Over-Load
200 mV	0.1 mV	100 K Ω	50 V
2 V	1 mV	100 K Ω	230 V
20 V	10 mV	1 M Ω	690 V
200 V	100 mV	1 M Ω	690 V
690 V	1 V	1 M Ω	690 V
Max 1 Min.			

Wiring Diagram



Input Signal: connect the signal to be monitored to the IN HI and the IN LO terminals. Note that the IN HI signal has two terminals that can be used, depending on the amount of Voltage being monitored. The upper IN HI terminal accepts 0.2, and 2 V. The lower IN HI terminal accepts the 20, 200, and 690 V input.



Supply Power: Connect the power to the supply power terminals. **Display Hold:** Short the terminals marked HOLD to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End"

Access to programming

Press the "S" key and the $\blacktriangle$. The display should show "PAS". During this phase the instrument asks for the password, which is a number from 0 to 199. The instrument is delivered with a password of 0. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "S" to enter the password.

If a number from 0 to 99 is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from 100 to 199. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

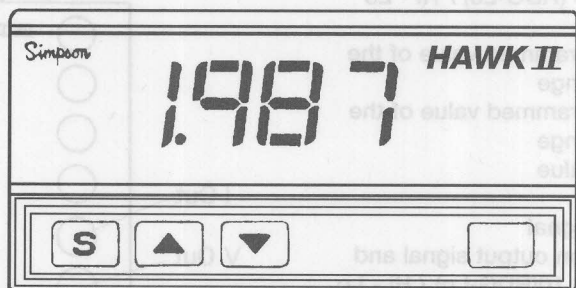
Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from **0** to **199**. Press "S" to move to the next parameter.

Decimal Point Selection

The display will show "dP" for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the ▲ and ▼ keys. Press "S" to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the "S" key. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (LOE to HiE)

Programmed display span: 0 to 100% (LO to Hi)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show "**Hi**" for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the ▲ and ▼ keys to change the displayed value. The maximum is **+1999**. Press the "S" key when the correct value is displayed.

The display will show "**LO**" signifying the minimum of the display span. The display shows the value stored in memory. To modify the value, use the ▲ and ▼ keys. The value can be as low as **0** in the AC Voltage meter. Press the "S" key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the **Programming the Relays** section.

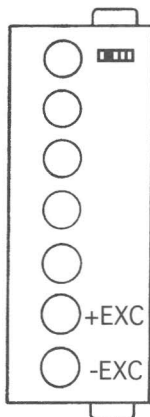
$$\left| \frac{\text{HiE} - \text{LOE}}{\text{Hi} - \text{LO}} \right| \pm 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

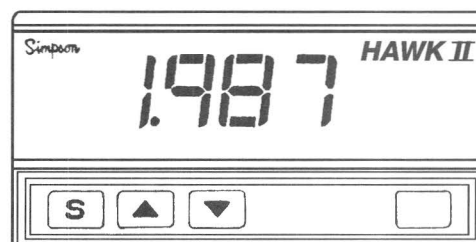
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo) + 4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-1 VDC Output signal

Relationship between output signal and displayed value: $V = (RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-10 VDC Output signal

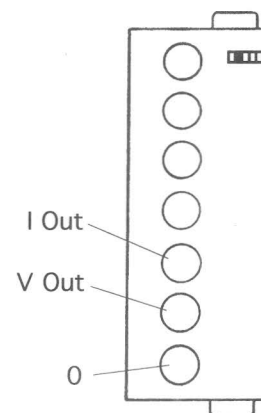
Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-1 V	Output 0-10 V
Overrange	EE	20 mA	1 V	10 V
Underrange	-EE	4 mA	0 V	0 V

Note:

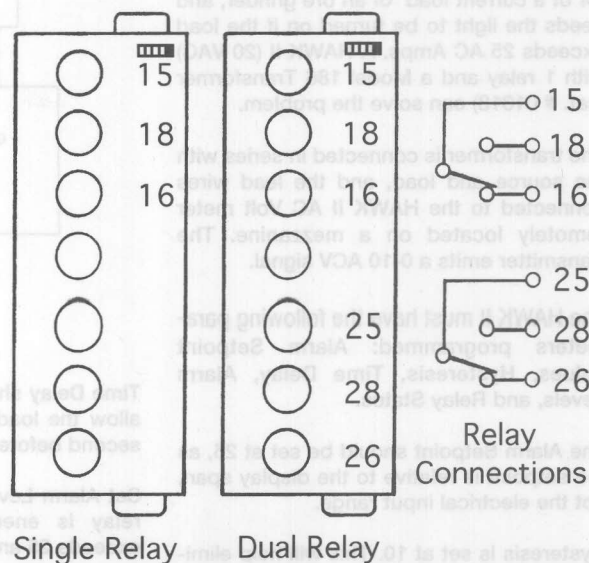
Analog output is not available in conjunction with Excitation

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ C	500 Ohm	N/A	Yes
0-1 V	±1% ±0.005V	±200 ppm/ C	N/A	≤3 Ohm	Yes
0-10 V	±1% ±0.05V	±200 ppm/ C	N/A	≤3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the set points.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the HI parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate "chatter" in the relays. The value is selected from 1 to 1999 counts.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the Setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the Setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm; Normally Energized, or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed, and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

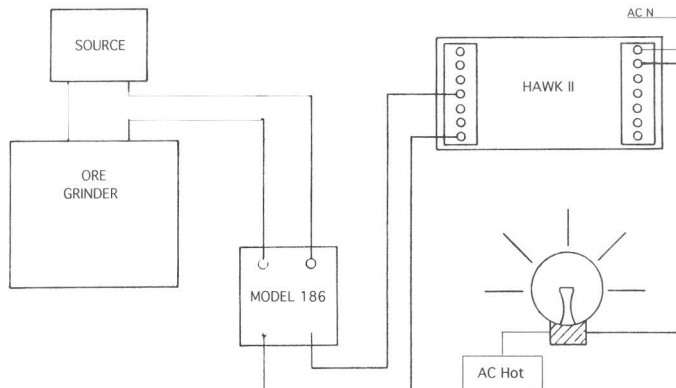
The plant supervisor wants a remote monitor of a current load of an ore grinder, and needs the light to be turned on if the load exceeds 25 AC Amps. A HAWK II (20 VAC) with 1 relay and a Model 186 Transformer (cat. # 01318) can solve the problem.

The transformer is connected in series with the source and load, and the lead wires connected to the HAWK II AC Volt meter remotely located on a mezzanine. The transmitter emits a 0-10 ACV signal.

The HAWK II must have the following parameters programmed: Alarm Setpoint Values, Hysteresis, Time Delay, Alarm Levels, and Relay Status.

The Alarm Setpoint should be set at 25, as the setpoint is relative to the display span, not the electrical input range.

Hysteresis is set at 10. This will help eliminate "chatter" in the relay.



Time Delay should be set at 1, which will allow the load to exceed 25 Amps for 1 second before activating the relay.

Set Alarm Level for up ("uP") so that the relay is energized when the current exceeds 25 amps.

Relay Status is normally de-energized ("nd").

To scale the display, HiE should be set at 10.0(V), and LOE set at 0.0(V). Hi should be set at 30.0(Amps) and Lo set at 0.0(Amps).

Ordering Information

Basic Unit		Output Signal		Excitation	
H235	3-1/2 Basic Unit	0	None	0	None
		1	4-20 mA	1	12 VDC
		2	0-1 V	2	24 VDC
		3	0-10 V		
Power Supply		Function/Range		Number of Relays	
1	120 VAC	0310	200 mV	0	None
2	220 VAC	0320	2 V	1	One
3	24 VAC	0330	20 V	2	Two
4	48 VAC	0340	200 V		
		0350	690 V		

Safety Symbols

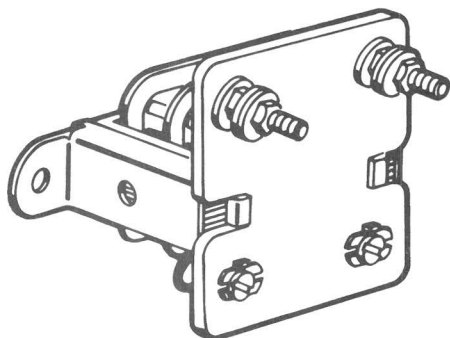
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

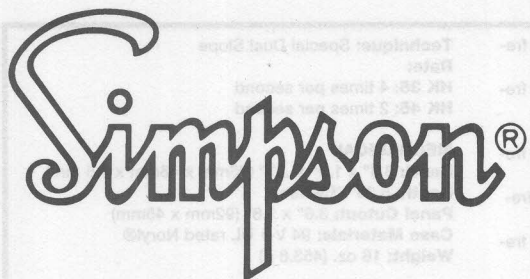


Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1999 Amps) is to be monitored at a remote location.

Additional information can be found in the Accessory Section.

Range	VA	Cat. Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



AC Voltage Controllers

Hawk HK35 & HK45 Series AC/AC TRMS 3-1/2 & 4-1/2 Digit

- Easily Programmed From the Front Panel
- Software Functions Include:

Password	Display Scaling
One or Two Setpoints	Decimal Point Selection
Time Delay & Hysteresis	
- 3-1/2 or 4-1/2 Digit, Bright Red 0.56" (14.2 mm) Display
- 2 Piece Screw Terminal Connector for Easy Installation
- 1/8 DIN Case, Made of High Impact Noryl®
- 5 AC/AC TRMS Voltage Ranges: 200 mV, 2 V, 20 V, 200 V, 750 V
- Display Hold
- Optional 5 Amp Relays and Analog/Digital Outputs

Simpson's Hawk Microprocessor based Controllers/Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Optional Peak Hold is available to replace the standard Display Hold on the AC TRMS units, allowing the operator to observe peak values in the input signal.

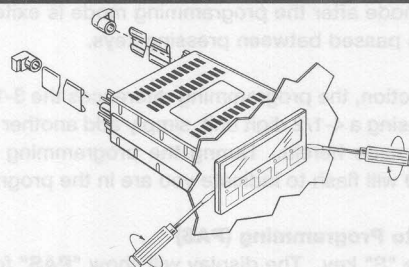
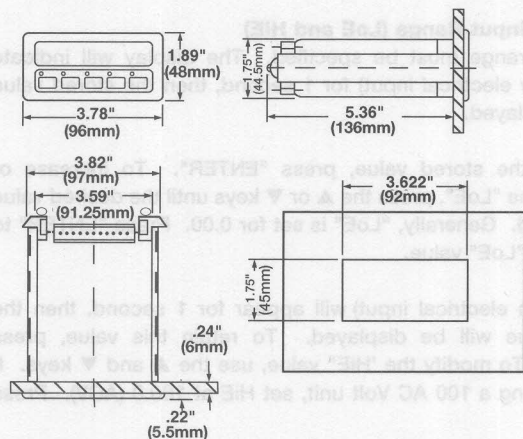
Two optional 5 Amp Relays include front programming features for Hysteresis, Time Delay, and Relay operation accessed through the front panel buttons. Optional Analog or Digital outputs are available for data communication for use with chart recorders and

computers. Other programmable software features include programmable decimal point and a password lockout feature. By using the password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact UL-94V 1 plastic Noryl®. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation and removal of the meter.



Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the mounting brackets, side retainers and screws provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, Red LED.

Height: 0.56" (14.2mm).

Decimal Point: 4 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA

ACCURACY @ 25° C

AC:

HK35: 0.3% of input ± 2 digit

HK45: 0.2% of input ± 2 digit

AC TRMS:

$\pm (0.2\% \text{ of input } \pm 2 \text{ digit})$ for crest factor ≤ 2 and frequency from 40 to 1KHz.

$\pm (0.4\% \text{ of input } \pm 5 \text{ digits})$ for crest factor ≤ 3 and frequency from 40 HZ to 1KHz.

$\pm (0.7\% \text{ of input } \pm 5 \text{ digits})$ for crest factor ≤ 6 and frequency from 40 HZ to 1 KHz.

AC TRMS w/ Peak Hold:

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 2 and frequency from 40 to 1KHz.

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 3 and frequency from 40 HZ to 1KHz.

$\pm (2.0\% \text{ of input } \pm 40 \text{ digit})$ for crest factor ≤ 6 and frequency from 40 Hz to 1 KHz.

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):

AC: $\pm 150 \text{ ppm/ } ^\circ\text{C}$

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 70 dB (1 K Ω unbalance) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate:

HK 35: 4 times per second

HK 45: 2 times per second

MECHANICAL

Bezel: 3.8" x 1.9" x .21" (96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

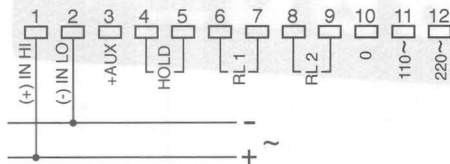
Case Materials: 94 V-1 UL rated Noryl®

Weight: 16 oz. (453.6 g)

Inputs: AC/AC TRMS Voltage

Input Range	Display Resolution		Max. Over-Load	Input Impedance
	HK 35	HK 45		
200 mV	100 μV	10 μV	50 V	1 M Ω
2 V	1 mV	100 μV	100 V	100 K Ω
20 V	10 mV	1 mV	100 V	1 M Ω
200 V	100 mV	10 mV	750 V	1 M Ω
750 V	1 V	100 mV	750 V	1 M Ω

Wiring Diagram



Input Signal:

Connect the input signal to the IN HI and the IN LO terminals (#1 and #2).

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Setpoint values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2"

LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" (Low electrical input) for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. Generally, "LoE" is set for 0.00. Press "ENTER" to lock in the "LoE" value.

"HiE" (High electrical input) will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the $\blacktriangle$ and $\blacktriangledown$ keys. If you are using a 100 AC Volt unit, set HiE at 100.0 (ACV). Press

Programming cont.

"ENTER" to lock in the new value, and to pass to the next parameter.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values from shunts or transformers, or a process. Following our previous example:

Electrical Input Range : 0 to 100.0 ACV (LoE to HiE)

Programmed Display Scaling: 0 to 50.0 psi (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "**Lo**" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter. In our example, the value is 0.0 (ACV).

The Display will show "**Hi**" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. In our example, when our process is using 100 Volts, the system is generating 50 psi. The value is 50.0 (psi). Press "ENTER" to lock in the new value and to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ keys. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "**SP**" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "**uP**" or "**do**" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "**dEL**" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-Energized ("nd"). Press "ENTER" to select the desired setting.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

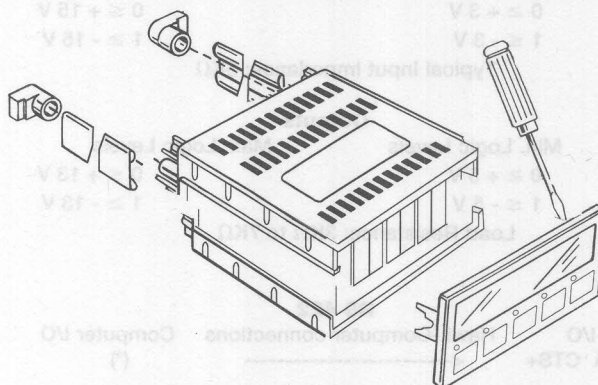
Exiting Programming Mode

After programming the relay(s), the Hawk will automatically exit the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it on to the case. Remove the "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.

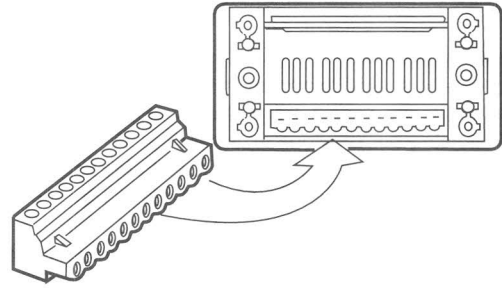


2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up. Extra terminal connectors are available from your Authorized Hawk Distributor.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

Hawk I/O	RS232C Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3 \text{ V}$	$0 \leq +15 \text{ V}$
$1 \leq -3 \text{ V}$	$1 \geq -15 \text{ V}$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5 \text{ V}$	$0 \leq +13 \text{ V}$
$1 \leq -5 \text{ V}$	$1 \geq -13 \text{ V}$

Load Resistance: 3K Ω to 7K Ω

Hawk I/O	RS 422 Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

Inputs

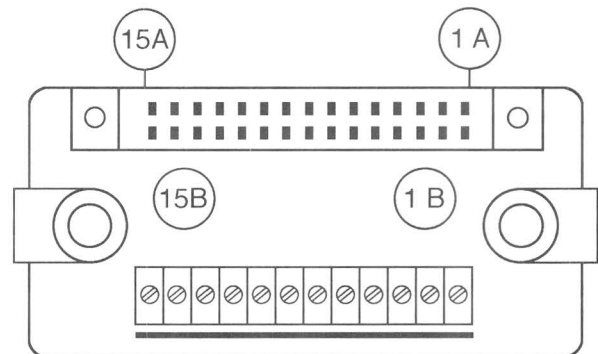
Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2 \text{ V (diff)}$	$0 \leq +12 \text{ V (diff)}$
$1 \leq -0.2 \text{ V (diff)}$	$1 \geq -12 \text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5 \text{ V (diff)}$	$0 \leq +5 \text{ V (diff)}$
$1 \leq -1.5 \text{ V (diff)}$	$1 \geq -5 \text{ V (diff)}$

Termination Resistances : 100 Ω $\pm$ 10%

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.



CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

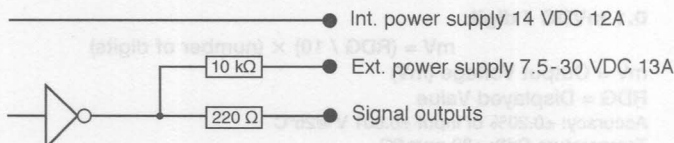
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector Output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(lsd)	2nd digit	3rd digit	4th digit	5th digit(msd)
Value Pin	Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B	*10,000 5A
2 2B	20 2A	200 6B	*2,000 10B	
4 3B	40 3A	400 7B	*4,000 11B	
8 4B	80 4A	800 8B	*8,000 12B	

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The Enable commands (active low) allow you to select the group of data outputs indicated in the table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mADC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for AC/AC TRMS Voltage controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mADC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mADC:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C(HK 35)

Temperature Drift: ± 120 ppm/°C (HK 40 and HK 45 RTD/TC)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

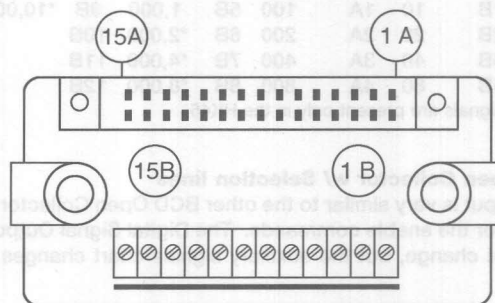
Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit Output Resistance $\leq 3\Omega$

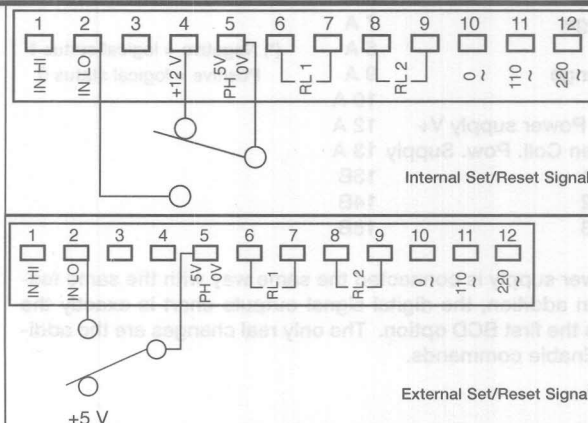
The signal outputs are protected from short circuits.



Peak Hold (AC TRMS only)

This optional feature can be controlled internally or externally. The display will briefly "Hold" the peak value, and slowly "decay" to the current input signal. The decay rate is approximately 1 digit per second for the 3-1/2 digit unit, and approximately 5 digits per second for the 4-1/2 digit unit. Display Hold is not available for use when Peak Hold is ordered with the Hawk because the two features use the same terminal contacts.

To measure peak values, apply zero volts DC to the Peak Hold input (terminal #5) by connecting terminal #5 to terminal #2. To clear the reading using the internal source, apply a minimum of 5 VDC through a maximum of 12 VDC to terminal #5. This can be accomplished by connecting terminal #4 to #5. To clear the reading using an external source, connect terminal #5 to an external reference.



Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels correspond to the display values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart to the right shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,
4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

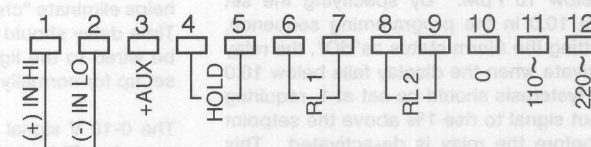
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals # 6 and #7, and relay #2 is wired from terminals #8 and #9.



Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on a siren and Alarm light #1 when the signal is below 60.0 Volts, and turn on Alarm light #2 when the signal is above 85.0 Volts.

Setpoint #1 should be set at 60.0, Alarm #1 set at "DOWN", and the relay set at "NE".

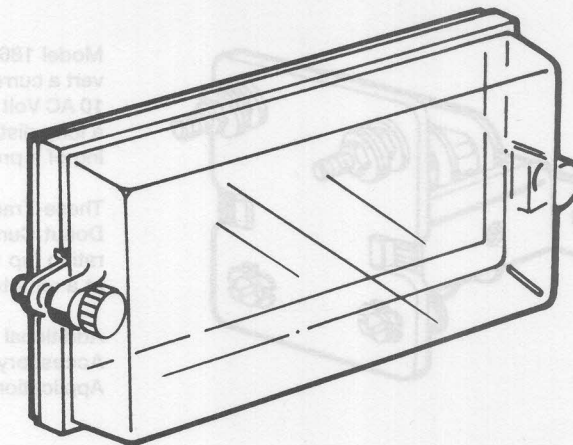
Setpoint #2 should be set at 85.0, Alarm #2 set at "UP", and the relay set at "NE".

NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front, by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the meter through the back half of the cover. Install the meter in the panel, and then screw the front half of the cover over the meter.



Application Example

A Design Engineer needs a controller that will display 100 Feet per Minute when a 20 AC Volt signal is applied. This signal is coming from a conveyor belt motor, which generates a linear speed output of 20 Volts at 100 feet per minute. In addition, a relay is needed to trigger a rotating light if the displayed speed falls below 10 (FpM). Finally, a 0-10 V output signal is needed. This will go to a chart recorder, which will mark a reading every 5 minutes.

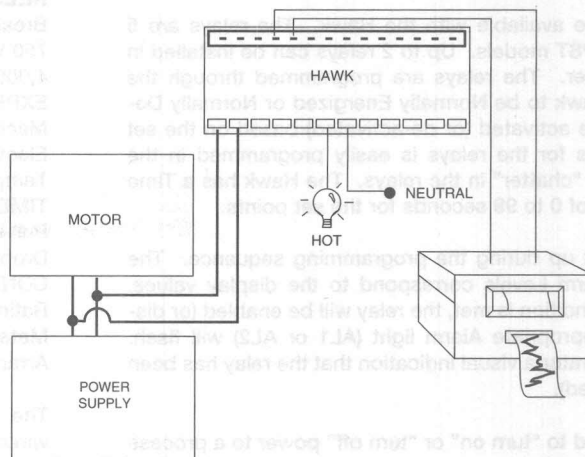
A 3-1/2 digit Hawk 20 AC Volt controller meets the application requirements. The display can be scaled to display Feet per Minute through the programming sequence. The HiE is set at 19.99, and the Hi is set at 100.0. The LoE and Lo are set at 0. When a signal is applied the meter will display 0-100.0 FpM.

A Relay can be set to activate when the signal falls below 10 FpM. By specifying the set point at 10.0 in the programming sequence, and setting the Alarm status as "dO", the relay will activate when the display falls below 10.0 FpM. Hysteresis should be set at 1, requiring the input signal to rise 1% above the setpoint value before the relay is de-activated. This

helps eliminate "chatter" in the relay. Also, the Time delay should be set at 0. The relay can be wired to the light circuitry, and should be set up for normally energized.

The 0-10 V signal can be wired to the chart recorder. This signal also works in a linear

progression, increasing the voltage from 0-10 as the display rises from 0-100. Pins 7A (over-range) and 9A (underrange) can be connected to warning lights, alerting the operator when and over/underrange situation occurs. In this state, a 5VDC signal is available. Otherwise, the signal is 0 VDC (typical values).



Ordering Information

Power Supply		Peak Hold*		Output Signal		Relays	
1	110/220 VAC	0	No	0	None	0	None
2	24/48 VAC	1	Yes	1	4-20 mA	1	One
3	9-32 VDC			2	0-1 V	2	Two
Basic unit				3	1 mV/digit (HK-35)		
HK 35	3-1/2 digit			4	0.1 mV/digit (HK-45)		
HK 45	4-1/2 digit			5	RS 232C		
AC		AC TRMS		6	RS 422	Excitation	
031	200 mV	051		7	BCD Open Col.	0	None
032	2 V	052		8	BCD TRI-STATE		
033	20 V	053		9	BCD O.C. W/ SEL. LINES		
034	200 V	054		A	0-10 V		
035	750 V	055					

* Please note that Peak Hold is only available with AC TRMS models.

NEMA 4 Cover : Catalog # 45003

Safety Symbols

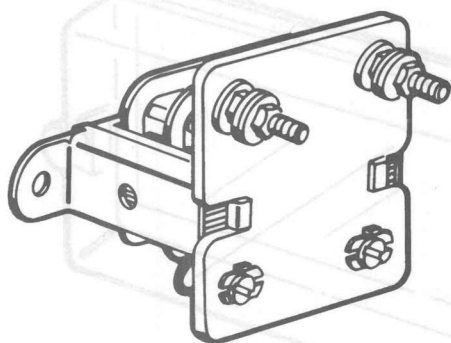
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

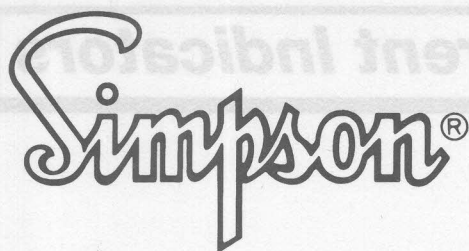


Model 186 Current Transformers easily convert a current signal (up to 50 Amps) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These Transformers can be coupled with a Donut Current Transformer if a high current rating (up to 1999 Amps) is to be monitored at a remote location.

Additional information can be found in the Accessory section of the Engineer's Application Guide.

Range	VA	Cat.Number
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01305
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321



DC Current Indicators



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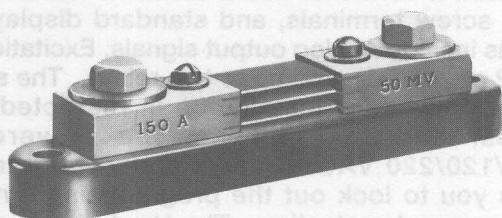
From compact 3/64 DIN mini indicators to 1/8 DIN controllers, Simpson offers a wide range of digital meters to fit your application requirements.

Simpson's line of DC Current indicators/controllers are available in 3 different panel cutout sizes. The Mini and Mini-Max indicators are 3/64 DIN, offering compact size with a large 0.5" LCD display. An optional negative image, red backlight LCD display is available for all the Mini and Mini-Max indicators. The Falcon indicators and Hawk/Hawk II controllers are 1/8 DIN size, and both styles have 0.56" LED displays. The 2800 series indicators require a 92mm by 42.72 mm cutout, and offer the same 0.56" LED display. The 2867 and 2868 indicators offer an optional Orange LED display, allowing easier viewing in darker areas.

Range

The Mini and 2800 series indicators can monitor up to 200 mA directly. The Falcon indicators and Hawk controllers can handle up to 2 Amps directly. The Mini-Max indicators and Hawk II controllers can monitor up to 5 Amps directly without the use of a shunt or transformer. If you have a higher current value to be monitored, it is advisable to use a portable or switchboard shunt (pictured below) and a Simpson digital volt meter.

Portable 150 Amp Shunt



The shunts monitor a current signal and emit a 50 mV signal. Information is available in the DC Volt section of this book.

Excitation Outputs

Excitation output is available in the Mini-Max and Falcon indicators, and in the Hawk/Hawk II controllers. A choice of 12 or 24 VDC is offered in all of these units.

Supply Power

Most units feature 120/220 VAC power supply. The 2800 series has an optional 5 VDC power supply, and the Mini-Max offers choice of 12/24/48 VDC power supply. The Falcon indicators and Hawk controllers have optional 9-32 VDC power supply, and the Hawk/Hawk II controllers have an optional 24/48 VAC power supply.

Display Hold

Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the DC Current signal.

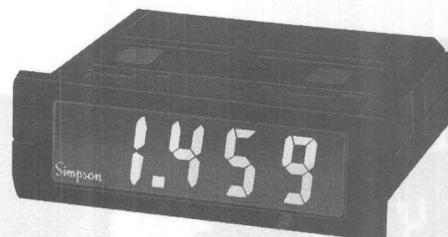
Relays, Analog and Digital Outputs

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in either the Hawk or Hawk II controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are available in both the Hawk and Hawk II controllers. The Hawk II has Analog output signals (4-20 mA, 0-1 V, and 0-10 V signals). The Hawk offers Analog or Digital output signals, such as RS 232/RS 422, as well as BCD output signals.



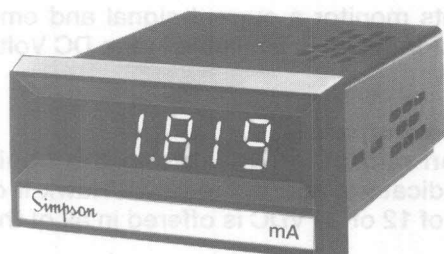
DC Current Indicators

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With a 3/64 DIN cutout, and 12 mm depth, Mini meters from Simpson fit the smallest panel spaces easily. Available in 3-1/2 or 4-1/2 digit LCD, or an optional negative image backlight LCD display. The mini requires 5 VDC, ± 5 VDC, or 9 VDC power supply. The Mini snaps into the panel, and does not require any mounting hardware. 12 pin mating connector with 6" lead wires is included.

With a 3/64 DIN cutout and 60 mm depth, Mini-Max fits small spaces easily. Available in 3-1/2 or 4-1/2 digit LCD display, and an optional negative image, red backlight display. A unique mounting bracket allows easy stacking of multiple units in one panel cutout, eliminating the need to tap multiple holes. Screw terminals are standard for easy wiring installation. Mini-Max can monitor up to 5 Amps.



The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. An optional Orange LED display is available for the 3-1/2 digit unit. Jumper selectable decimal point allows flexibility of this meter in your application. The 2800 series can monitor up to 200 mA direct.



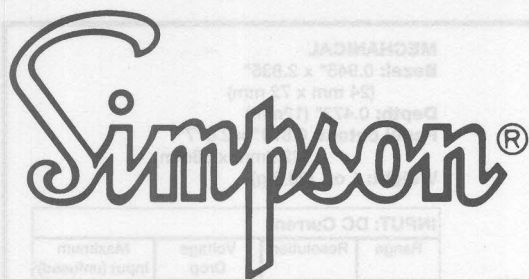
Falcon F35 and F45 indicators are low cost indicators that can monitor 200 μ A through 2 Amps. These units offer broad range scaling to any engineering unit. The Falcon series can be modified in the field to accept a different range by moving selected jumpers on the main board. A standard 1/8 DIN cutout is required, and mounting hardware is included with each unit.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include dual relays, and Analog/Digital output signals. Excitation outputs (12 or 24 VDC) are available for powering transmitters and other accessories. An optional 9-32 DC power supply is available for the Hawk controller. The Hawk can monitor 200 μ A through 2 Amps.



The Hawk II controller has a standard NEMA 4 front panel, screw terminals, and standard display hold. Options include Analog output signals, Excitation output (12 or 24 VDC), and up to two relays. The shallow depth allows easy installation in restricted panel spaces, and the unit can be powered by 24/48/120/220 VAC. User friendly programming allows you to lock out the programming functions with password protection. The Hawk II can monitor up to 5 Amps.



DC Current Indicators

MINI M135 Series

3-1/2 Digit

- **Minimum Depth Indicator! Less than 0.5" (12.7 mm) of Space Required Behind the Panel!**
- **Fits 3/64 DIN Standard Cutout, 22.2 mm x 68 mm**
- **3-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Optional Negative Image, Bright Red Backlighting**
- **12 Pin Mating Connector With 6" Lead Wires Included for Easy Installation**
- **Display Hold Standard on All Units**
- **4 Current Ranges: 200 μ A, 2 mA, 20 mA, 200 mA**
- **3 Power Supply Alternatives: 5 VDC, $\pm$ 5 VDC, or 9 V Battery (With Low Battery Indication)**



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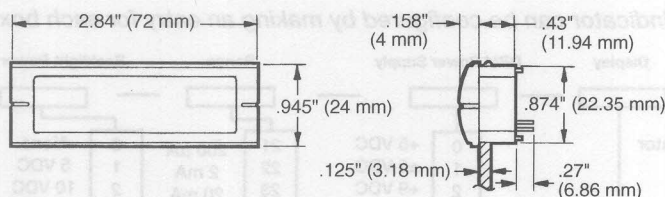
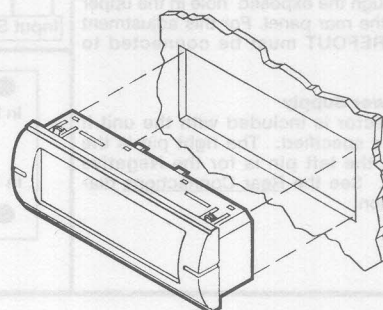
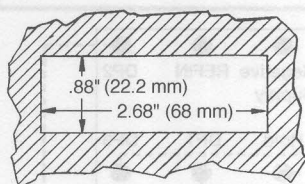
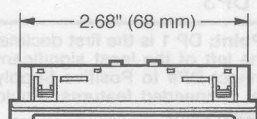
Simpson's Mini DC Current Indicators provide high quality, accuracy and reliability in a compact 12 mm deep case. The M135 has a 3-1/2 digit, 0.5" LCD display and is available with a negative image, bright red backlight option. Mini M135 meters feature user selectable decimal point and display hold.

battery indication is provided for 9 V battery applications.

Mini units feature a standard 3/64 DIN high impact plastic case. The negative image, bright red backlit units have a red window, and the non-backlit units have a clear viewing window.

Three power supply choices are available, and a low

Installation and Panel Cutout



*No mounting hardware required, snaps right into panel!

Mounting Requirements

The Mini indicators require a panel cutout of 2.68" (68mm) wide by 0.88" (22mm) high, and a panel area of 0.945" (24mm) high by 2.84" (72mm) wide. The depth behind the panel, including terminals, is 0.7" (17.8mm). The front bezel protrudes 0.158" (4mm) from the front of the mounting surface. The unit will snap mount into panels from 0.050" to 0.125" thick. A 12 pin connector with 6" wire leads is included with each unit for quick installation.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 3 position programmable

Overrange indication: Most significant = "1"

Backlighting: Optional negative image, red LED backlighting at 5, 10, 12, 24, or 48 VDC

POWER REQUIREMENTS

DC Power: ± 5 V, +5 V, and +9 V

(Low battery indication provided with 9 V units)

Power supply current: 2 mA max

Backlight supply current: 50 mA typical

For 24 and 48 VDC, 10 mA typical

ACCURACY @ 25°C:

$\pm(0.1\%$ of reading + 1 count)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60 °C

Relative Humidity: 0 to 85% non-condensing

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (with 1 K Ω unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.945" x 2.835"

(24 mm x 72 mm)

Depth: 0.473" (12mm)

Panel cutout: 0.874" x 2.677"

(22.2mm x 68mm)

Weight: 1 oz. (28.3 g)

INPUT: DC Current

Range	Resolution	Voltage Drop	Maximum Input (unfused)
200 μ A	100 nA	200mV	10 mA
2 mA	1 μ A	200mV	40 mA
20 mA	10 μ A	200mV	100 mA
200 mA	100 μ A	200mV	400 mA

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Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

A reversed polarity power supply will permanently damage this instrument.

CAUTION

IN HI and IN Low must remain within the limits of the power supply.

A positive reading will be displayed when IN HI is more positive than IN Low.

Internal Reference: REFOUT must always be connected to REFIN unless an external reference is being used.

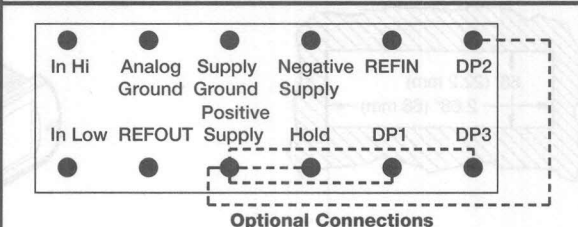
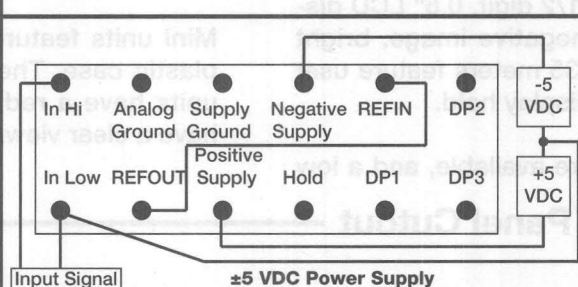
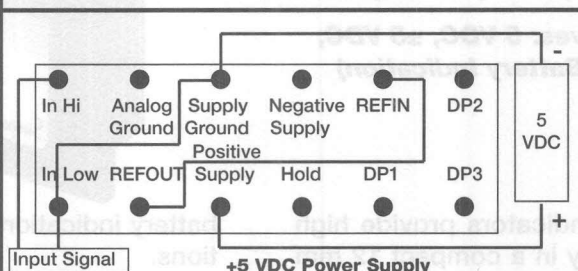
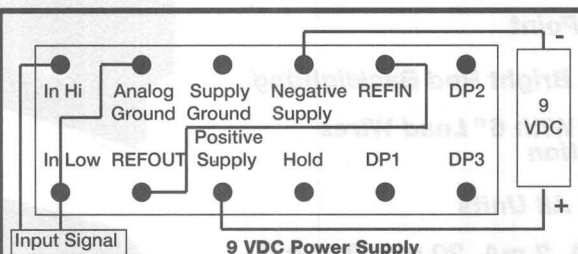
External Reference: Connect between REFIN and ANALOG GROUND; REFOUT should then be unconnected (open). For best results, external reference voltage should be in the range of 50 mV to 150 mV. System stability is then only as good as the external reference.

Calibration, Scaling and Offset

Model M135 has a limited range adjustment for calibration. Apply the appropriate voltage input for a near full scale reading, typically 1900 counts on the display. The adjustment is accessed through the exposed hole in the upper left corner of the rear panel. For this adjustment to function, REFOUT must be connected to REFIN.

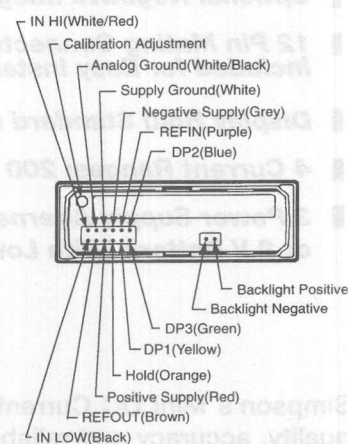
Backlight Power Supply

A 2 pin connector is included with the unit if backlighting is specified. The right pin is the Positive, and the left pin is for the Negative power supply. See the **Rear Connections** diagram for location.

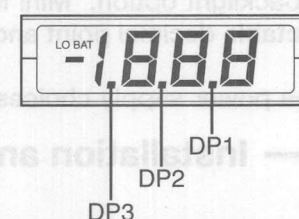


Mini M135

Rear Connections



Decimal Point



Decimal Point: DP 1 is the first decimal point to the left of the least significant digit. Connect DP# to Positive Supply to activate. Unused features should remain unconnected.

Display Hold: The display can be held indefinitely by connecting Hold to Positive Supply. The display will function normally when this connection is removed.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

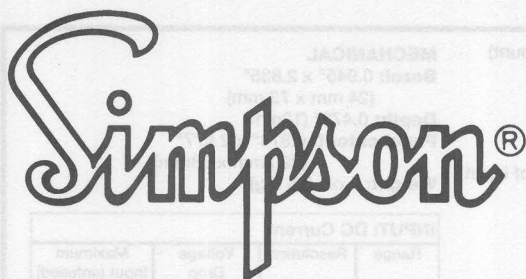
CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Your Mini Current Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Backlight Power
M135	3-1/2 Digit Indicator	0 +5 VDC 1 ± 5 VDC 2 +9 VDC	21 200 μ A 22 2 mA 23 20 mA 24 200 mA	0 None 1 5 VDC 2 10 VDC 3 12 VDC 4 24 VDC 5 48 VDC
	0 Non Backlight 1 Negative Image Red			



DC Current Indicators

MINI M145 Series 4-1/2 Digit

- **Minimum Depth Indicator! Less than 0.5" (12.7 mm) of Space Required Behind the Panel!**
- **Fits 3/64 DIN Standard Cutout, 22.2 mm x 68 mm**
- **4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Optional Negative Image, Bright Red Backlighting**
- **12 Pin Mating Connector With 6" Lead Wires Included for Easy Installation**
- **Display Hold Standard on All Units**
- **4 Current Ranges: 200 μ A, 2 mA, 20 mA, 200 mA**
- **3 Power Supply Alternatives: 5 VDC, $\pm$ 5 VDC, or 9 V Battery (With Low Battery Indication)**
- **Broad Range Display Scaling**



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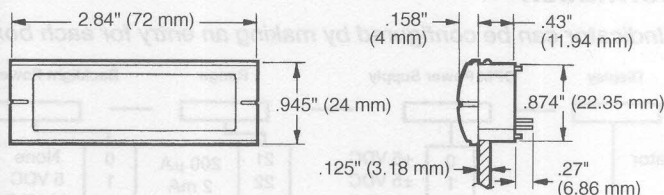
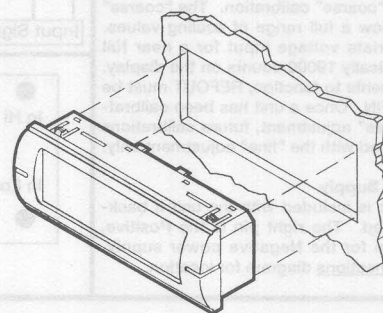
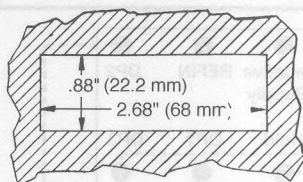
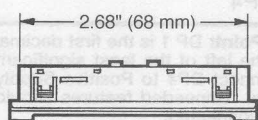
Simpson's Mini DC Current Indicators provide high quality, accuracy and reliability in a compact 12 mm deep case. The M145 has a 4-1/2 digit, 0.5" LCD display and is available with a negative image, bright red backlight option. Mini M145 meters feature user selectable decimal point and display hold.

battery indication is provided for 9 V battery applications.

Mini units feature a standard 3/64 DIN high impact plastic case. The negative image, bright red backlit units have a red window, and the non-backlit units have a clear viewing window.

Three power supply choices are available, and a low

Installation and Panel Cutout



*No mounting hardware required, snaps right into panel!

Mounting Requirements

The Mini indicators require a panel cutout of 2.68" (68mm) wide by .88" (22mm) high, and a panel area of 0.945" (24mm) high by 2.84" (72mm) wide. The depth behind the panel, including terminals, is 0.7" (17.8mm). The front bezel protrudes 0.158" (4mm) from the front of the mounting surface. The unit will snap mount into panels from 0.050" to 0.125" thick. A 12 pin connector with 6" wire leads is included with each unit for quick installation.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 4 position programmable

Overrange indication: Most significant = "1"

Backlighting: Optional negative image, red LED backlighting at 5, 10, 12, 24, or 48 VDC

POWER REQUIREMENTS

DC Power: ± 5 V, +5 V, and +9 V

(Low battery indication provided with 9 V units)

Power supply current: 2 mA max

Backlight supply current: 50 mA typical
For 24 and 48 VDC, 10 mA typical

ACCURACY @ 25°C: $\pm(0.04\%$ of reading + 1 count)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60 °C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient: (All inputs) $\pm(0.02\%$ of input ± 0.2 digit) / °C

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (with 1 K Ω unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.945" x 2.835"

(24 mm x 72 mm)

Depth: 0.473" (12mm)

Panel cutout: 0.874" x 2.677"

(22.2mm x 68mm)

Weight: 1 oz. (28.3 g)

INPUT: DC Current

Range	Resolution	Voltage Drop	Maximum Input (unfused)
200 μ A	10 nA	200mV	10 mA
2 mA	100 nA	200mV	40 mA
20 mA	1 μ A	200mV	100 mA
200 mA	10 μ A	200mV	400 mA

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

A reversed polarity power supply will permanently damage this instrument.

CAUTION

IN HI and IN Low must remain within the limits of the power supply.

A positive reading will be displayed when IN HI is more positive than IN Low.

Internal Reference: REFOUT must always be connected to REFIN unless an external reference is being used.

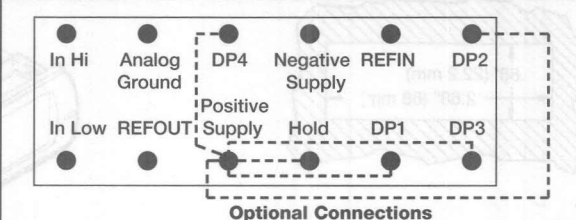
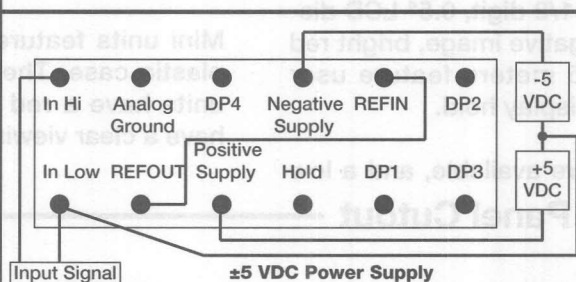
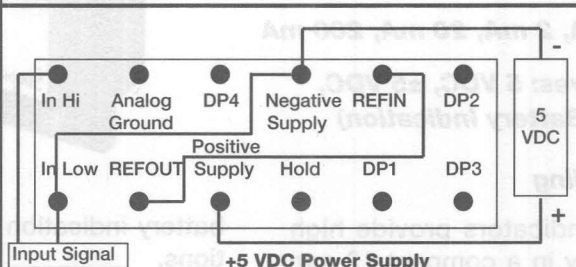
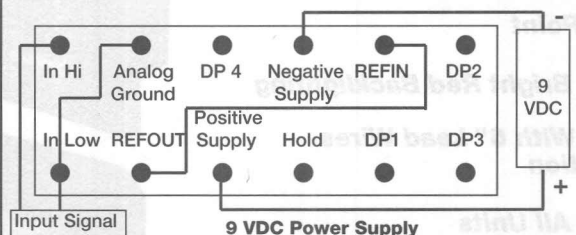
External Reference: Connect between REFIN and ANALOG GROUND; REFOUT should then be unconnected (open). For best results, external reference voltage should be in the range of 0.5 V to 1.5 V. System stability is then only as good as the external reference.

Calibration, Scaling and Offset

Model M145 has two internal scaling adjustments on the rear panel, one that is covered by a label, and one that is always exposed. The exposed adjustment is a "fine" calibration point, and the covered adjustment is for "coarse" calibration. The "coarse" calibration will allow a full range of scaling values. Apply an appropriate voltage input for a near full scale reading, typically 19000 counts on the display. For these adjustments to function, REFOUT must be connected to REFIN. Once a unit has been calibrated with the "coarse" adjustment, future calibrations should be performed with the "fine" adjustment only.

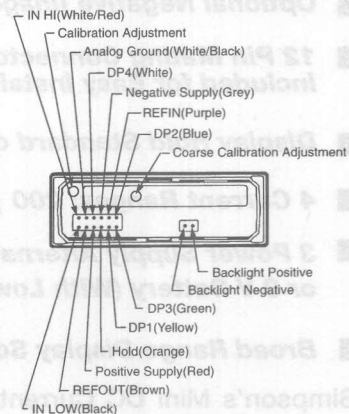
Backlight Power Supply

A 2 pin connector is included with the unit if backlighting is specified. The right pin is the Positive, and the left pin is for the Negative power supply. See the Rear Connections diagram for location.



Mini M145

Rear Connections



Decimal Point



Decimal Point: DP 1 is the first decimal point to the left of the least significant digit. Connect DP# to Positive Supply to activate. Unneeded features should remain unconnected.

Display Hold: The display can be held indefinitely by connecting Hold to Positive Supply. The display will function normally when this connection is removed.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

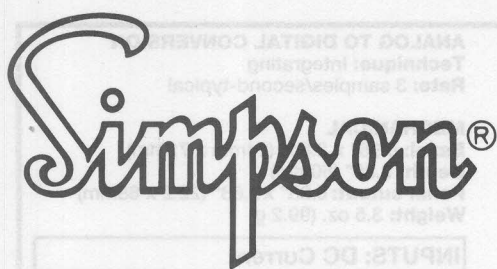
CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Your Mini Current Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Backlight Power
M145	4-1/2 Digit Indicator	0 +5 VDC 1 ± 5 VDC 2 +9 VDC	21 200 μ A 22 2 mA 23 20 mA 24 200 mA	0 None 1 5 VDC 2 10 VDC 3 12 VDC 4 24 VDC 5 48 VDC
	0 Non Backlight 1 Negative Image Red			



DC Current Indicators

MINI-MAX M235/M245 Series 3-1/2 & 4-1/2 Digit Indicators

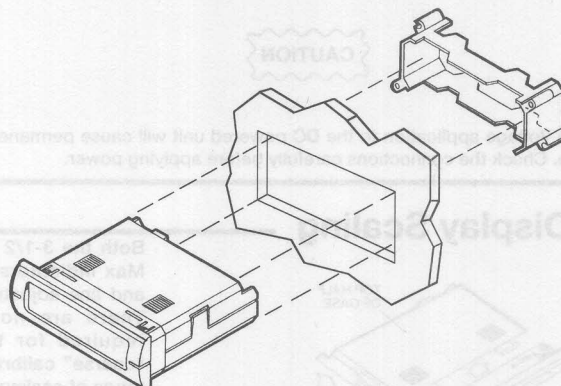
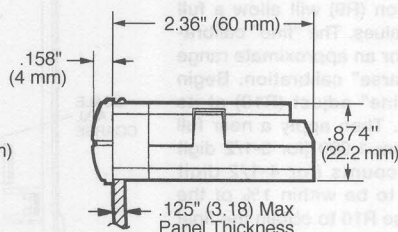
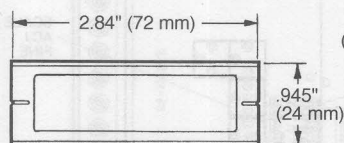
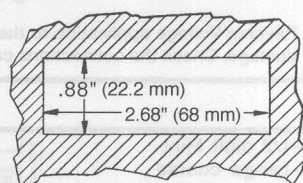
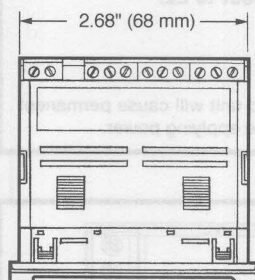
- **Shallow Depth Indicator! Less Than 2.5" (60 mm) of Space Required Behind the Panel**
- **Fits 3/64 DIN Standard Cutout, 22.2mm x 68mm**
- **Stackable Mounting Bracket Included for Easy Installation**
- **3-1/2 or 4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Broad Range Display Scaling**
- **Optional Negative Image Bright Red Backlighting**
- **Standard Screw Terminals for Easy Installation**
- **6 Current Ranges: 200 μ A, 2mA, 20mA, 200mA, 2 A, 5 A**
- **120/220 VAC, or 12/24/48 VDC Isolated Power**

Simpson's Mini-Max Current Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units offer choice of 3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, and scaling capabilities. Display hold is standard on 3-1/2

and optionally available for the 4-1/2 digit units. A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All Mini-Max units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.

Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 3 position programmable (3-1/2) or 4 position programmable (4-1/2)

Overrange indication: Most significant digit = "1"

Backlighting: Optional negative image, red LED backlighting

POWER REQUIREMENTS

AC Voltages: 120 (90-132) VAC @40-440 Hz

220 (180-264 Max.) VAC @40-440 Hz

DC Voltages: 12/24/48 VDC ($\pm 10\%$)

Power Consumption:

AC powered units: 3 VA min/12 VA max

DC powered units: 12 V @ 150 mA max;

24 V @ 80 mA max; 48 V @ 50 mA max.

Rated Circuit to Ground Voltage: 750 VRMS

ACCURACY @ 25°C

200 μ A - 200 mA

M235: $\pm(0.1\%$ of reading + 1 count)

M245: $\pm(0.02\%$ of reading + 1 count)

2 A

M235: $\pm(0.25\%$ of reading + 1 count)

M245: $\pm(0.25\%$ of reading + 1 count)

5 A

M235: $\pm(0.5\%$ of reading + 1 count)

M245: $\pm(0.5\%$ of reading + 1 count)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

DC Units: $\pm(0.01\%$ of input ± 0.05 count)/°C

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (with 1 K Ω unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.95" x 2.84" (24mm x 72mm)

Depth: 2.36" (60mm)

Panel cutout: 0.88" x 2.68" (22.2 x 68mm)

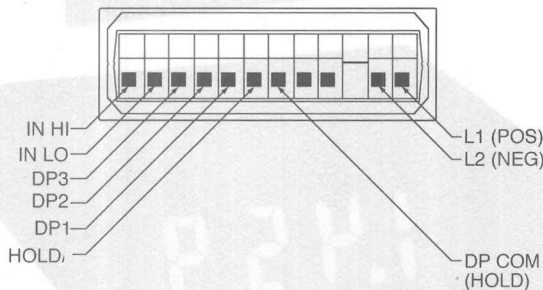
Weight: 3.5 oz. (99.2 g)

INPUTS: DC Current

Range	Resolution M235	Resolution M245	Voltage Drop	Max Input (unfused)
200 μ A	100 nA	10 nA	200mV	10mA
2 mA	1 μ A	100 nA	200mV	40mA
20 mA	10 μ A	1 μ A	200mV	100mA
200 mA	100 μ A	10 μ A	200mV	400mA
2 A	1 mA	100 μ A	200mV	3A
5 A	10 mA	1mA	200mV	6A

B
7
6

M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, or DP3) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

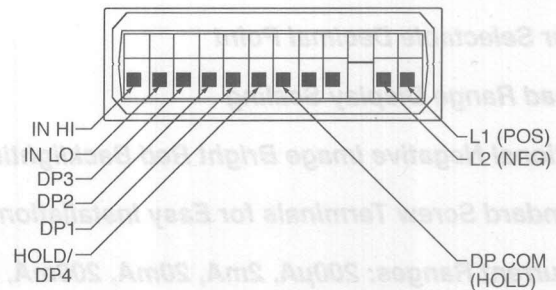
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

M245 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, DP3, or DP 4) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open). Hold is optional with the 4-1/2 digit Mini-Max, and when so equipped replaces DP4. Available through our modification centers.

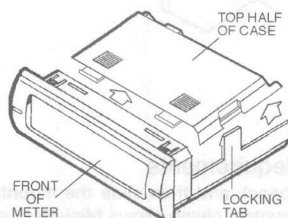
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.

CAUTION

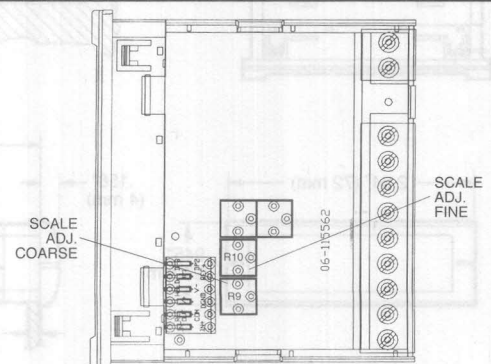
Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

Display Scaling



Using a screwdriver or thumbnail spread tab on each side of case to unlock top half. Lift rear of top half and slide away from front of meter.

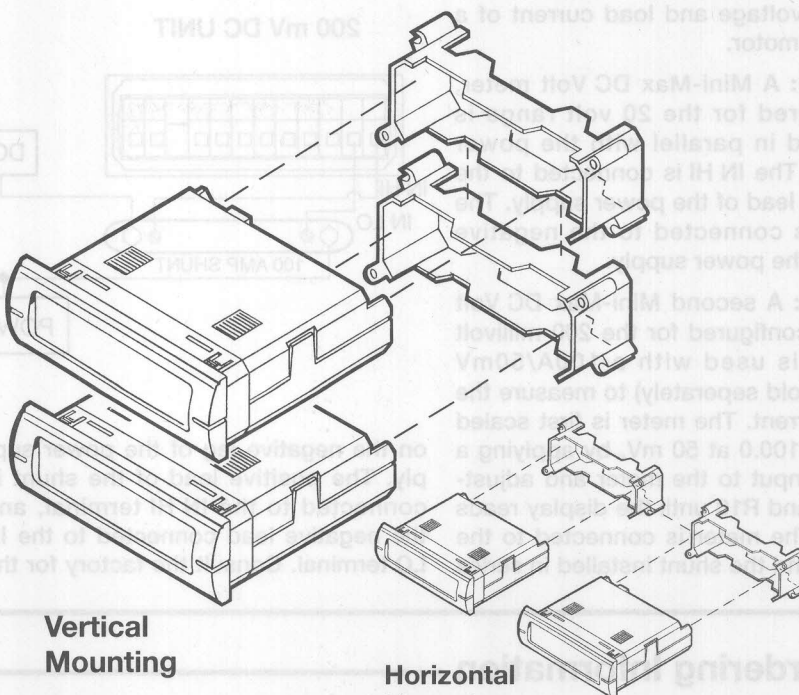
Both the 3-1/2 and the 4-1/2 digit Mini-Max indicators have **full-range** coarse and fine adjustments for display scaling. There are no optional connections required for these to function. The "coarse" calibration (R9) will allow a full range of scaling values. The "fine" calibration (R10) allows for an approximate range of 1% of the "coarse" calibration. Begin by placing the "fine" adjust (R10) at its center of rotation. Then apply a near full scale input of either 1,900 (for 3-1/2 digit units) or 19,000 counts (for 4-1/2 digit units). Adjust R9 to be within 1% of the final value, then use R10 to obtain the final desired result.



Stacking Features

The mounting clips that come with every Mini-Max can be connected together. This allows multiple units to be mounted in one hole (no need to punch one hole per meter). Perfect alignment in the panel can be achieved, as only one hole is made.

For DC applications, Mini-Max 2-Packs provide economical and reliable voltage and current measurement capabilities in our most popular ranges. The power requirement is 120 VAC. Mounting the two units is very simple. The bottom unit is installed first, then the mounting clip is attached to the top of the bottom unit. Finally the top meter is installed into the top clip.

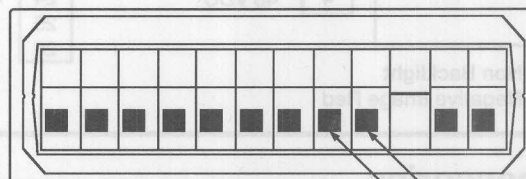


2-Pack DC Voltage/Current Indicators

Catalog No.	Voltage	Current	Backlight
M35021	2V	200 mA	None
M35022	20V	2 A	None
M35122	20V	2 A	Negative Red
M35023	200V	5 A	None
M35123	200V	5 A	Negative Red

Excitation Output

Excitation output is optionally available in the Mini-Max for powering external transmitters or transducers. Excitation is available from the EX POS and EX NEG terminals. This source is isolated from the measurement input as well as the input power circuits. The voltage available is 12 VDC with a maximum load current of 20 milliamps. This feature eliminates the need to mount an external DC power source for transducers or sensors used in your application.



CAUTION

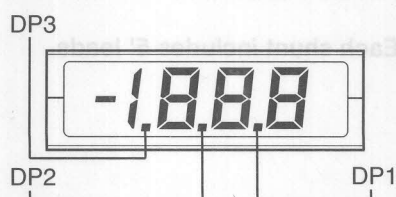
Do not exceed an excitation load current of 20 mA!

EX NEG
EX POS

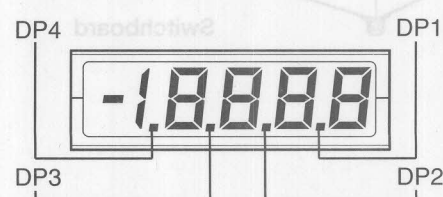
Backlight Option

Negative image, bright red, LED backlighting is available in the Mini-Max M235 and M245. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini-Max, so no additional external power supply is required.

Decimal Point 3-1/2



Decimal Point 4-1/2

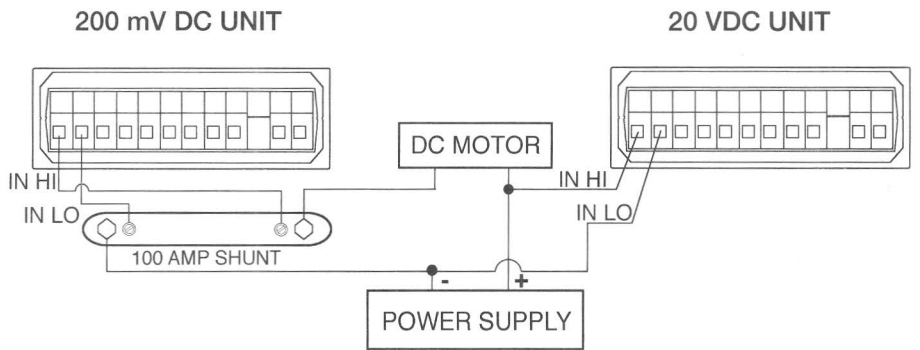


Application Example

There is a need to monitor the power supply voltage and load current of a 12 VDC motor.

Voltage: A Mini-Max DC Volt meter, configured for the 20 volt range is installed in parallel with the power source. The IN HI is connected to the positive lead of the power supply. The IN LO is connected to the negative lead of the power supply.

Current: A second Mini-Max DC Volt meter, configured for the 200 millivolt range, is used with a 100A/50mV shunt (sold separately) to measure the load current. The meter is first scaled to read 100.0 at 50 mV, by applying a 50 mV input to the meter and adjusting R9 and R10 until the display reads 100.0. The meter is connected to the shunt, and the shunt installed in series



on the negative leg of the power supply. The positive lead of the shunt is connected to the IN HI terminal, and the negative lead connected to the IN LO terminal. Consult the factory for the

resistor values required.

The Mini-Max units will indicate the power supply voltage and load current of the motor.

Ordering Information

Your Mini-Max Current Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Excitation Output
M235 M245	3-1/2 Digit Indicator 4-1/2 Digit Indicator	0 1 2 3 4	11 21 22 23 24 25 26	0 1
		120 VAC 220 VAC 12 VDC 24 VDC 48 VDC	200mV 200uA 2mA 20mA 200mA 2A 5A	None 12 VDC
	0 1			
	Non Backlight Negative Image Red			

Safety Symbols

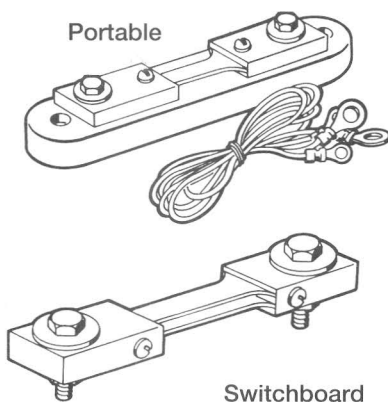
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



External shunts enable digital panel meters to indicate higher currents than can be provided with self-contained internal shunt meters. The shunt is installed in series with the load and source. The shunts produce a DCmV drop which is sent to the display unit. The Mini-Max can be scaled to display the actual current between the load and the source. Simpson manufactures Portable and Switchboard shunts.

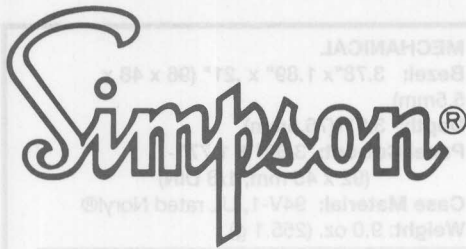
Each shunt includes 5' leads.

Portable Shunts 50 mV

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts 50 mV

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

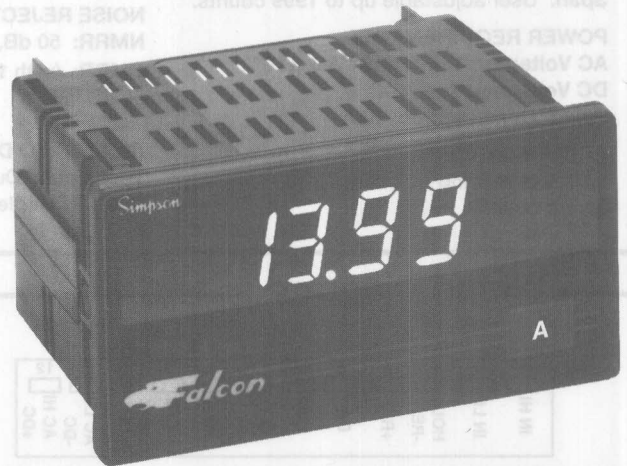


DC Current Indicators

Falcon F35 Series 3-1/2 Digit

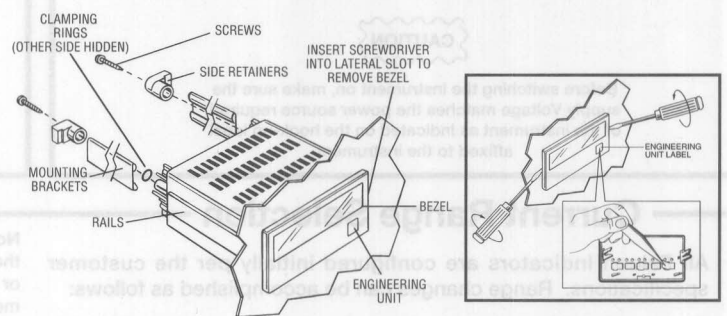
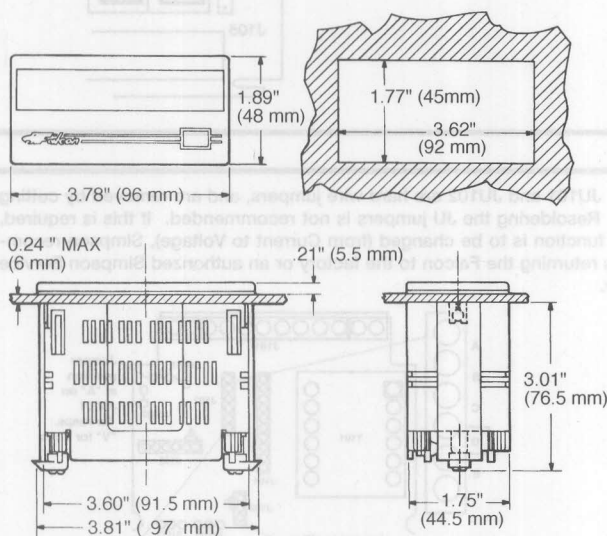
- Full 3-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200 μ A, 2mA, 20mA, 200mA, 2 A
- Jumper Selectable Decimal Point
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply
- Optional Excitation Output of 12 VDC or 24 VDC

The Falcon Series digital indicators are premium quality 1/8 DIN meters for industrial applications with display scaling capability. All Falcon units feature jumper selectable decimal point (internal and on the connector for remote decimal point), providing wide application flexibility. In addition, signal input ranges are easy to change with jumpers on the main board. The Falcon has a 0.56" bright red LED display for high



visibility and an optional NEMA 4 cover to protect the display in washdown environments. Compactly designed for applications requiring minimal rear panel depth, the Falcon fits a standard 1/8 DIN panel cutout (92mm x 45mm) and requires only 3.01" behind the panel. A screw terminal connector is a standard feature for easy wiring of the power supply and signal input connections.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove the screws, side retainers, and mounting brackets from the rails as shown above. Position the Falcon into the cutout. From the rear of the panel, slide the panel mounting brackets back on to the rails until the brackets are flush against the back of the panel. Replace the side retainers and screws.

Engineering Label Placement

If replacement of the engineering unit label is required, insert a small screwdriver into the lateral slot on side of bezel and gently turn the screwdriver until the bezel snaps away from the case. Use tweezers to remove and replace the engineering unit label. Gently snap the bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED
Height: 0.56" (14.2mm)
Decimal Point: 3 position programmable, internally or on the terminal block.
Overrange indication: 3 least significant digits blank, above 1999 counts.
Polarity: Automatic, with "-" indication, "+" indication implied.
Span: User adjustable up to 1999 counts.

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$
DC Voltages: 9-32 VDC
Power Consumption: 3VA

ACCURACY @25°C

$\pm 0.1\%$ of reading ± 1 count
 $2A \pm 5$ count

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -10 to 60°C
Relative Humidity: 0 to 85% non-condensing
Temperature Coefficient:
 $(\pm 0.01\% \text{ of input} \pm 0.05 \text{ count})/^{\circ}\text{C}$
Warm-up Time: Less than 15 minutes
Response Time: Less than 1 second

NOISE REJECTION

NMRR: 50 dB, 50/60 Hz
CMRR: (with 1K Ω unbalanced @ 60 Hz): 90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration
Rate: 3 samples per second, nominal

MECHANICAL

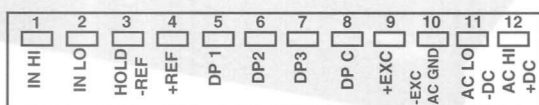
Bezel: 3.78" x 1.89" x .21" (96 x 48 x 5.5mm)
Depth: 3.01" (76.5mm)
Panel Cut-out: 3.62" X 1.77" (92 x 45 mm, 1/8 DIN)
Case Material: 94V-1, UL rated Noryl®
Weight: 9.0 oz. (255.1 g)

Inputs:

DC Current

Input Range	Display Resolution	Maximum Input	Voltage Drop
200 μA	100 nA	20 mA	200 mV
2 mA	1 μA	20 mA	200 mV
20 mA	10 μA	100 mA	200 mV
200 mA	100 μA	500 mA	200 mV
2 A	1 mA	2.2 A	200 mV

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. IN HI is terminal #1, IN LO is terminal #2.

Supply Power: Connect the supply power to terminals #11 and #12. Note that if AC power is supplied, terminal #11 is for Neutral, and terminal #12 is for Hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch can be used to make the connection. To activate the display hold, short terminal blocks #3 and #4 (Hold Ref and +Ref).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

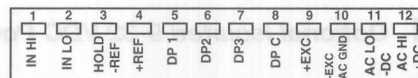
CAUTION

Before switching the instrument on, make sure the supply Voltage matches the power source required of the instrument as indicated on the hook-up label affixed to the instrument

Decimal Point Selection

From terminal block: The decimal point can be set from the rear screw terminal block by connecting the appropriate decimal point (DP 1, 2, 3,) to the DP C terminal. The J105 jumper must be in the D position (see diagram under "From front panel").

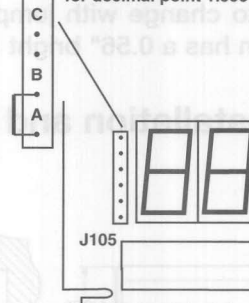
Decimal Point	Connect
1.999	DP C to DP1
19.99	DP C to DP2
199.9	DP C to DP3
1999	No Decimal



From front panel: The decimal point can also be selected by removing the front bezel from the meter. Move the push-on jumper J105 across the correct letter.

Decimal Point	Jumper Position at J105
1.999	A
19.99	B
199.9	C
1999	D*
* No Decimal Point	

Exploded view showing jumper position "A" at J105 for decimal point 1.999



Current Range Selection

All Falcon Indicators are configured initially per the customer specifications. Range changes can be accomplished as follows:

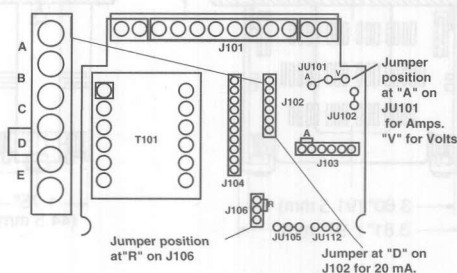
Remove the screws, brackets, and side retainers from the unit. Next, remove the O-rings from the two rear posts where the brackets are screwed in. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

If a new range is selected, the calibration procedure must also be performed. See the chart below for jumper locations.

Input Range	J102	J106	JU101	JU102
200 μA	A	R	A	NO
2 mA	B	R	A	NO
20 mA	D	R	A	NO
200 mA	E	R	A	NO

If you need to change a Falcon from (or to) a 2 Amp unit, please consult the factory or an Authorized Service Center.

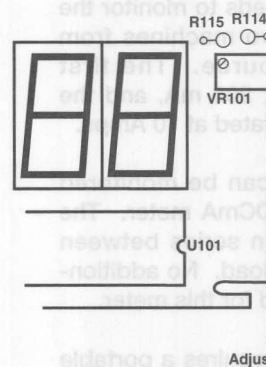
Note: JU101 and JU102 are hard wire jumpers, and are removed by cutting them. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed (from Current to Voltage), Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center.



Display Scaling

The Falcon can be easily scaled to display any engineering unit. For example, if a 200 mA signal is being monitored, and you want the meter to display 0-120.0%:

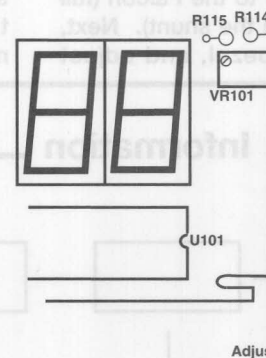
- 1) Remove the front bezel with a small screwdriver.
- 2) Apply the maximum signal input for the meter (199.9 mA signal).
- 3) Adjust the potentiometer VR101 located on the right side of the display board to display the maximum reading desired (120.0%). Maximum value is adjustable from 1200 - 1999; for other ranges, please consult the factory.
- 4) Replace the bezel carefully. A card of labels is provided for alternative engineering units such as percent.



Calibration

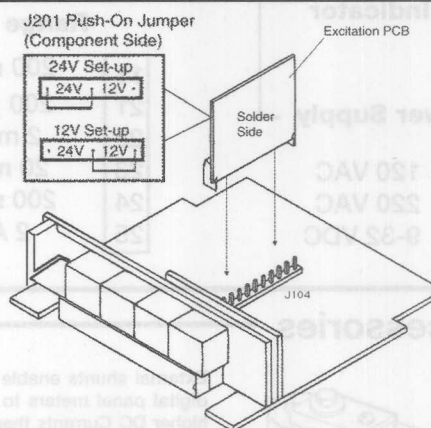
The Falcon is calibrated at the factory per order. If you change the range, and have moved the jumpers, your Falcon will need to be recalibrated.

- 1) Remove the bezel with a small screwdriver.
- 2) Apply an input signal to the connector.
- 3) Adjust the potentiometer (VR101) located on the right side of the display board until the display indicates the value of the input signal or desired display value. For example, if a 19.99 V signal is applied, adjust the potentiometer until the display indicates 19.99 (V).
- 4) Replace the bezel carefully, and install the meter.



Excitation Output

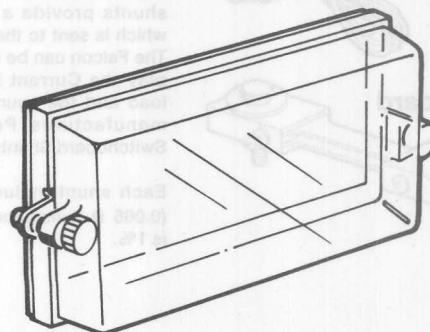
An optional feature of the Falcon is the 12 VDC or 24 VDC Excitation output. The Falcon is set at the factory per your order to include an Excitation plug-in printed circuit board in the range you specify. Excitation supply allows you to power external transformers and transducers without having to set up additional DC power sources for them. If your application changes, you can easily change the Excitation value. The Excitation supply can be reconfigured by moving push-on jumper J201 (located on the Excitation board). To change the Excitation output value, move the jumper to the correct position shown in the diagram.



Nema 4 Cover

An optional NEMA 4 cover is available for use with all Falcon series indicators. This cover will help protect the meter in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



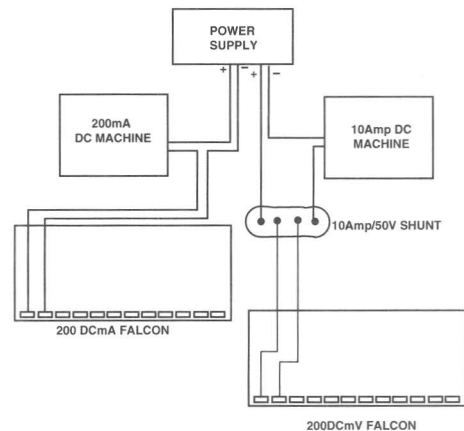
Application Example

A Plant manager needs to monitor the Current draw of two machines from one DC power source. The first machine is rated at 200 mA, and the second machine is rated at 10 Amps.

The first machine can be monitored with a Falcon 200 DCmA meter. The meter is installed in series between the source and the load. No additional scaling is required for this meter.

The second meter requires a portable shunt (10 Amps/50 mV) and a Falcon 200 DCmV meter. The second meter needs to be scaled before being installed into the panel. A 50 mV signal must be applied to the Falcon (full strength signal from the shunt). Next, remove the front bezel, and adjust

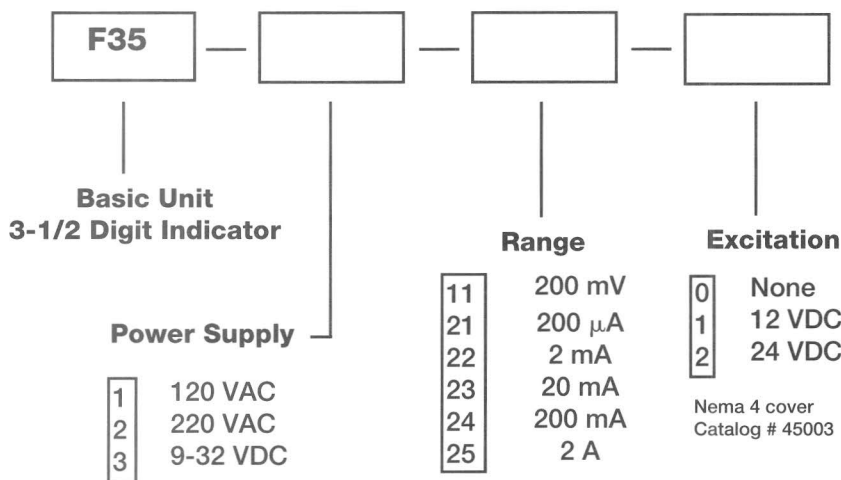
potentiometer VR101 until the display indicates 10.0 Amps. Replace the bezel, and remove the signal. The shunt is installed in series between the source and the load, and the meter is connected to the shunt in



parallel. The two lead wires included with the shunt are connected to terminals #1 and #2, located on the rear of the Falcon. Be sure to place a jumper across R114 when using a 10 Amp/50 mV shunt.

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Ordering Information



Safety Symbols

WARNING

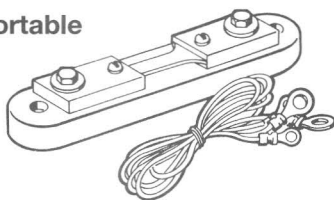
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

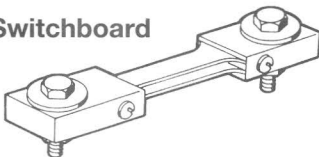
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

Portable



Switchboard



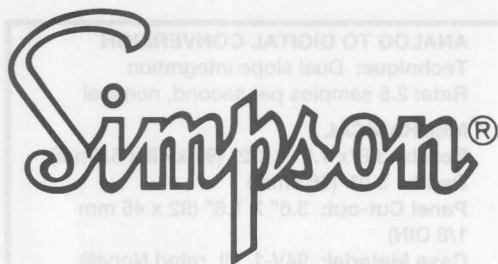
External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Falcon can be scaled to display the Current between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

Each shunt includes 5' leads (0.065 Ω resistance). Accuracy is 1%.

Portable Shunts *					Switchboard (50 mV)*		
Amp	Voltage Drop	Jumper Across R114	Range of Readout	Catalog Number	Amp	Voltage Drop	Catalog Number
1	50	Yes	1.00	06700	100	50	06500**
5	50	None	5.00	06703	150	50	06503**
10	50	Yes	10.0	06704	200	50	06504**
15	50	Yes	15.0	06705	250	50	06505**
20	50	Yes	20.0	N/A	300	50	06506
25	50	Yes	25.0	06707	400	50	06507
30	50	None	30.0	06708	500	50	06508
50	50	None	50.0	06709			
75	50	None	75.0	06711			
100	50	Yes	100	06713			
150	50	Yes	150	06714			
200	50	Yes	200	06715			
10	100	Yes	10.0	06716			
30	100	Yes	30.0	N/A			
100	100	None	100.0	06717			
200	100	Yes	200	N/A			
10	200	Yes	10.00	N/A			
20	200	Yes	20.0	N/A			
100	200	Yes	100.0	N/A			
200	200	None	199.9	N/A			

* Portable and Switchboard shunts should be used with 200 mV meters.

** These Switchboard shunts require a jumper across R114.



DC Current Indicators

Falcon 45 Series 4-1/2 Digit

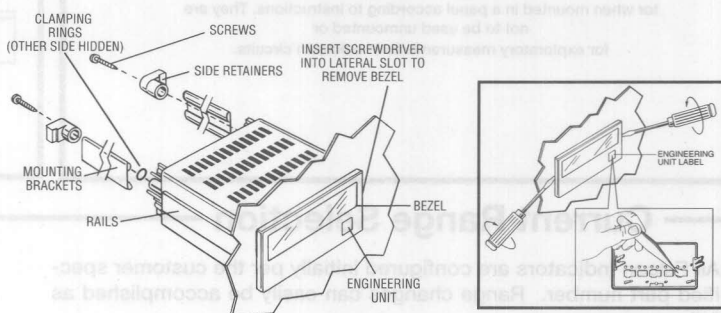
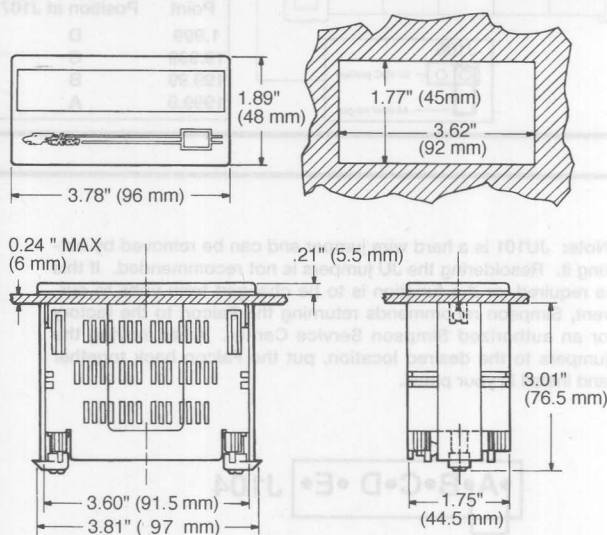
- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Precision Microprocessor Design
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200 μ A, 2mA, 20mA, 200mA, 2A
- Optional NEMA 4 Splash Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply

The Falcon Series digital indicators are premium quality 1/8 DIN meters for rough industrial applications with multi-function and range capability. All DC Current units feature display scaling and selectable decimal point providing the ultimate in application flexibility. The meter is designed to operate from either 120 VAC, 220 VAC, 50 to 400 Hz, or 9 to 32 VDC.



For high visibility, the Falcon has a 4-1/2 digit 0.56" bright red LED display and uses precision circuitry to provide a basic accuracy of 0.05% $\pm$ 1 digit. A screw type terminal block is provided standard for easy installation and a NEMA 4 splash-proof lens cover is available for wash down areas.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 4 position programmable internally or at terminal block J112.

Overrange indication: 1 and 4 LSD blank with polarity sign.

Polarity: Automatic, with "-" indication, "+" indication implied.

Span: User selectable-19999 to +32563 with a scale factor 6 maximum.

Scale Factor:

$$M = \frac{\text{Hi-Lo}}{\text{HiE-LoE}}$$

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC; 9V -1% and 32+1%

Power Consumption: 2VA

ACCURACY @25° C

$\pm 0.05\%$ of reading ± 1 count

2A ± 5 count

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

($\pm 0.01\%$ of input ± 0.1 digit)/°C

Warm-up Time: Less than 15 minutes

Response Time: Less than 1 second

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/1k Ω unbalance @ 60 Hz):

90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Rate: 2.5 samples per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .22" (96 x 48 x 5.5mm)

Depth: 3.01" (76.5mm)

Panel Cut-out: 3.6" X 1.8" (92 x 45 mm 1/8 DIN)

Case Material: 94V-1, UL rated Noryl®

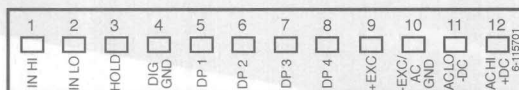
Weight: 9.0 oz. (255.1 g)

INPUTS: DC Current

Input Range	Display Resolution	Max. Input Current	Voltage Drop
200 mA	10 nA	20 mA	200 mV
2 mA	100 nA	20 mA	
20 mA	1 mA	100 mA	
200 mA	10 mA	500 mA	
2 A	100 mA	2.2 A	

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Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. These are terminals #1 and #2.

Supply Power: Connect the power to terminals #11 and #12. Note that if AC power is applied, terminal #11 is for neutral, and terminal #12 is for hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch or computer, etc. can be used to activate this feature. To install this feature, short circuit terminal block J112, Pins 3 and 4 (Hold and DIG GND).

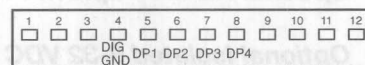
WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

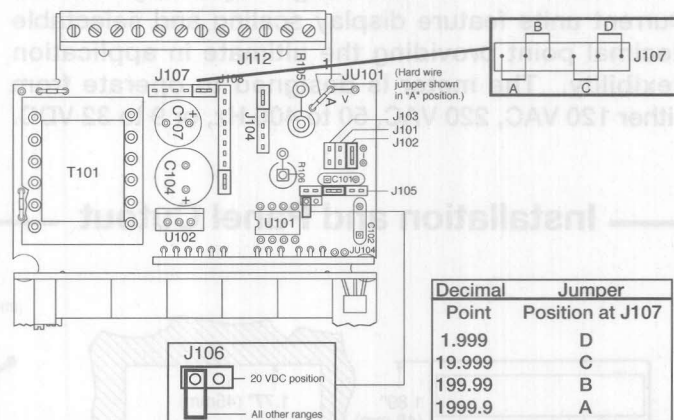
Decimal Point Selection

From terminal block J112: The decimal point can be set from the rear screw terminal block J112. Connect the appropriate DP point (DP 1, 2, 3, 4) to the DIG GND terminal. Internal jumper (J107) should be removed and stored on the last contact of J107.

Decimal Point	Connect
1.9999	DIG GND to DP1
19.999	DIG GND to DP2
199.99	DIG GND to DP3
1999.9	DIG GND to DP4



From main board: The decimal point can also be selected by removing the top half of meter case. Move the push-on jumper J107 across the correct letter.



Decimal Point	Jumper Position at J107
1.999	D
19.999	C
199.99	B
1999.9	A

Current Range Selection

All Falcon Indicators are configured initially per the customer specified part number. Range changes can easily be accomplished as follows:

Remove the brackets and sliding rails from the unit. Next, remove the O-rings on the rear bracket mounts. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

Note: If a new range is selected, the calibration procedure must also be performed. Only perform this section if a different function or range is required.

Input Range	J104 PJ	JU101 Jumper Position
200 μ A	A	A
2mA	B	A
20mA	D	A
200mA	E	A

* 2 Amp range may be configured upon order by factory or authorized Simpson Modification Center

Note: JU101 is a hard wire jumper and can be removed by cutting it. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed from volts to current, Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center. After moving the jumpers to the desired location, put the Falcon back together and install in your panel.



Example: 200 μ A input

Display Scaling

The Falcon display can be easily scaled to display any engineering unit. Remove the front bezel with a small screwdriver. The scaling procedure is performed at terminal J1 located on the left side of the display board. There are four sets of pins on J1 as shown in the drawing. Each group of pins programs a particular parameter of the scaling procedure when a push-on jumper (supplied with Falcon) is momentarily placed across a set of pins.

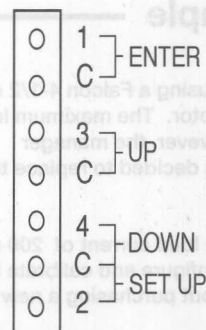
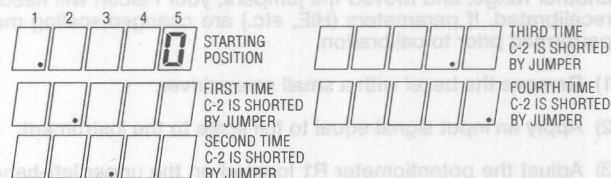
Before scaling the parameters, begin by disconnecting power to the Falcon. Place push-on jumper onto "SETUP" pins C and 2. Then apply power. At this point the Falcon performs a self test (scrolls LED display showing numerals 1 through 5) and then indicates LoE allowing you to enter the low electrical input value.

The scaling parameters for electrical low input value(LoE), electrical high input value(HiE), display low value(Lo), and display high value (Hi) are performed in the same manner as follows:

Remove push-on jumper from C-2 and then replace. Numeral zero or digit of LoE value (set at the factory) and flashing decimal point are displayed at starting LED position. The digit to be entered is always to the left of the flashing decimal point. The flashing decimal point is moved one position each time the push-on jumper is momentarily placed across "SETUP" pins C and 2. Change the value at the LED position chosen by momentarily placing jumper across "UP" pins C and 3. This will increase the value by 1 for each repetition. Repeat jumper placement until desired value is displayed. To decrease a display value, momentarily place jumper across "down" pins C and 4.

After the desired numeric value is obtained it is necessary to remove the jumper and momentarily place it across the "ENTER" pins C and 1 to store value in memory. LED display indicates next parameter. Repeat this procedure through each parameter.

After programming the last parameter (Hi) of the scaling procedure, LED will display "END" and then indicate scaled value of electrical input to the meter. The unit is now in "run" mode.



Enter-Saves digits displayed and advances to next scaling parameter when jumper makes momentary contact with pins 1 and C.

UP-Changes digit displayed to next ascending value when jumper makes momentary contact with pins 3 and C.

DOWN-Changes digit displayed to next descending value when jumper makes momentary contact with pins 4 and C.

SETUP-Starts scaling cycle of the four scaling parameters (LoE, HiE, Lo and Hi) and selects digit to be entered to the left of the flashing decimal point on display when jumper makes momentary contact with pins 2 and C.

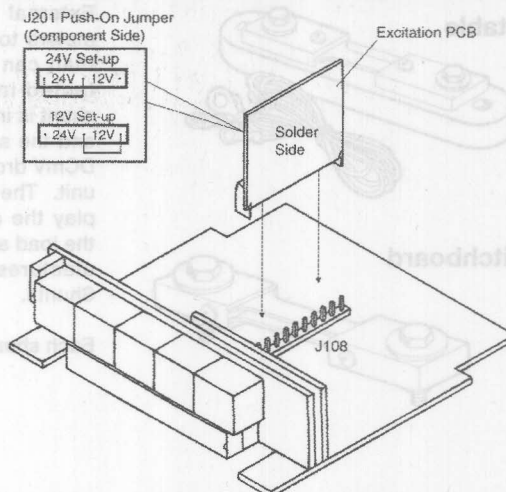
Typical Scaling Application

200mA range is used

Electrical Characteristics	Falcon LED Display	
Current: 200mA	LoE: 0	Lo: 0
Display: 100%	HiE: 199.99	Hi: 100.00

Excitation Output

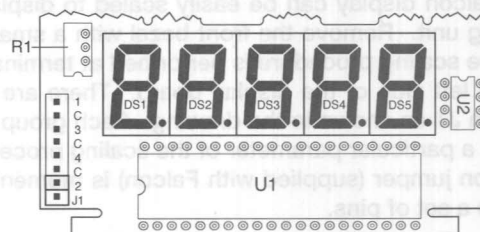
An optional feature of the Falcon is a 12 or 24 VDC output. The Falcon is set at the factory per your order to include an excitation plug-in printed circuit board. This PCB, located on the main board can be reconfigured by moving push-on jumper J201 to change the excitation output as shown in the diagram.



Calibration

The unit is calibrated at the factory per order. If you selected another range, and moved the jumpers, your Falcon will need to be recalibrated. If parameters (HiE, etc.) are changed, scaling must be performed prior to calibration.

- 1) Remove the bezel with a small screwdriver.
- 2) Apply an input signal equal to full scale to the instrument.
- 3) Adjust the potentiometer R1 located on the upper left-hand side of the display board until display shows the full scale current.
- 4) Replace bezel carefully

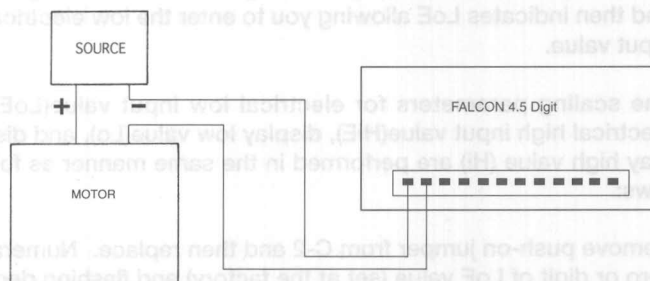


Application Example

A machine shop manager has been using a Falcon 4-1/2 digit unit to measure load current of a motor. The maximum load current has been 20 milliams. However, the manager needs to update the system and has decided to replace the motor.

The new motor will have a maximum load current of 200 milliams. The manager can simply configure and calibrate the same Falcon to the new range without purchasing a new unit.

After changing the appropriate jumpers on the main board (J104 from D to E), the unit is configured for 0(mA) for both LoE and Lo and 200(mA) for both HiE and Hi.



Next, the indicator is calibrated and installed in series with the source and the motor. The input wires are connected to terminals one and two.

Ordering Information

F45			
Basic Unit			
4-1/2 Digit Indicator			
Power Supply		Range	Excitation
1 120 VAC	11 200 mV	0 None	
2 220 VAC	21 200 μ A	1 12 VDC	
3 9-32 VDC	22 2 mA	2 24 VDC	
	23 20 mA		
	24 200 mA		
	25 2 A		
			Nema 4 cover Catalog # 45003

Safety Symbols

WARNING

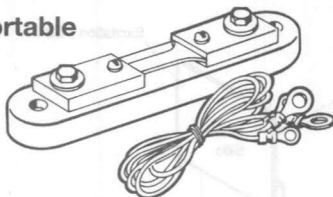
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

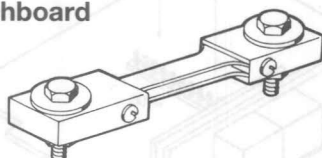
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Portable



Switchboard



External shunts enable digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Falcon can be scaled to display the actual Current load between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

Each shunt includes 5' leads.

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

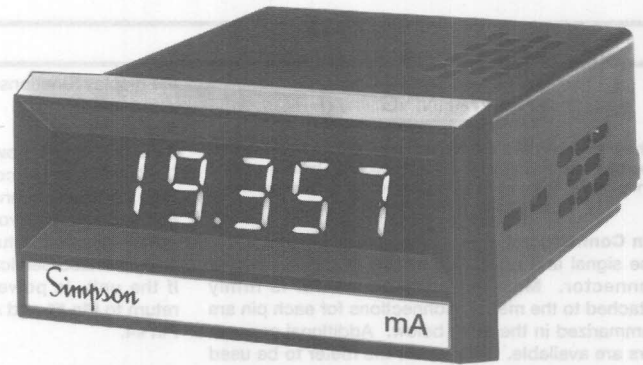
Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Indicators

2842 & 2843 Series 4-1/2 Digit

- **5 Current Ranges: 20 μ A, 200 μ A, 2 mA, 20 mA, 200 mA**
- **Jumper Selectable Decimal Point**
- **Input/Output Edge Connector**
- **4-1/2 Digit, 0.56" Red LED Display**
- **Model 2842 Requires 117 VAC Power Supply**
- **Model 2843 Requires 5 VDC Power Supply**
- **Optional 234 VAC Power Supply**
- **Optional Display Hold**
- **Additional Rear Terminal Connector Available**
- **Optional Cutout Adapters**
- **Optional "U" Shaped Mounting Bracket**

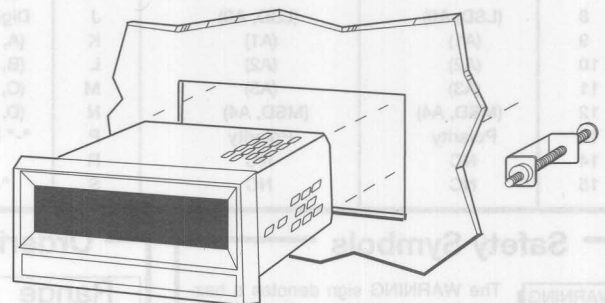
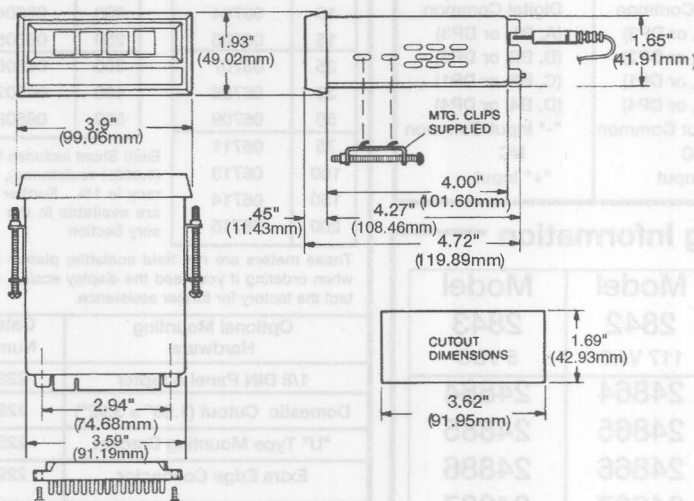


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Simpson's 2842 and 2843 Series meters offer high accuracy with up to 1 nA resolution. Model 2842 requires a 117 VAC supply at 50-400 Hz, and Model 2843 requires a 5 VDC supply at 500 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 4-1/2 digit display is easily readable from a distance (about 25 feet). Panel adapters are available for

1/8 DIN panel cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. The optional Display Hold is activated from the rear connector (when ordered). Typically a switch (not supplied) is used to activate the Display Hold so the operator may take a reading from the display.

Installation and Panel Cutout



Mounting Instructions

The 2842 and 2843 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Display Hold

This optional feature must be specified when ordering. By shorting Pin H to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display) and to take a reading. The switch is then turned off, and

high (or low) is connected to Pin L. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center. If the unit is powered by VDC, attach the VDC return to Pin #1 and A. The "+" VDC is connected to Pin #4.

BCD Outputs

The unit is shipped configured with BCD outputs. If Remote Decimal Point is chosen, the BCD output must be disconnected. The unit uses the same connector points for both features.

Remote Decimal Point

This option allows you to remotely select different decimal points without opening the meter to make the changes. This option can be installed by the factory or one of our Authorized Service Centers. Remote Decimal Point uses the same terminal points as BCD outputs, eliminating the BCD capabilities if specified.

Pin Number	2842 Circuit	2843 Circuit	Pin Number	2842 Circuit	2843 Circuit
1	3rd wire GND	5VDC Return	A	3rd wire GND	5 VDC Return
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	(Strobe)	(Strobe)	H	(Hold/Remote DP Common)	(Hold/Remote DP Common)
8	(LSD, A0)	(LSD, A0)	J	Digital Common	Digital Common
9	(A1)	(A1)	K	(A, B1, or DP3)	(A, B1, or DP3)
10	(A2)	(A2)	L	(B, B2, or DP2)	(B, B2, or DP2)
11	(A3)	(A3)	M	(C, B3, or DP1)	(C, B3, or DP1)
12	(MSD, A4)	(MSD, A4)	N	(D, B4, or DP4)	(D, B4, or DP4)
13	Polarity	Polarity	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

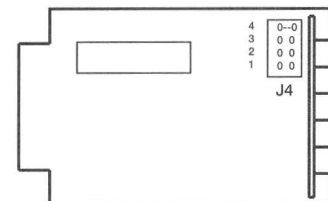
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model	Model
	2842	2843
	117 VAC	5 VDC
20 μ A	24864	24884
200 μ A	24865	24885
2 mA	24866	24886
20 mA	24867	24887
200 mA	24868	24888

Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
4	1000.0
1	100.00
2	10.000
3	1.0000



The Jumper Positions are printed on the main circuit board of the meter. After moving the jumper to the location you selected, slide the circuit board back into the meter case and re-assemble the meter.

Accessories

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

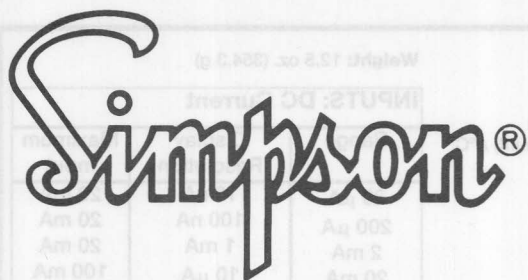
Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Each Shunt includes 5' leads (0.065 Ω resistance), Accuracy is 1%. Further details are available in the Accessory Section

These meters are not field scalable; please specify when ordering if you need the display scaled, or contact the factory for further assistance.

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Extra Edge Connector	22990

Please see the Accessory Section for full details on Mounting Hardware.



DC Current Indicators

2865, 2866, 2867 & 2868 Series 3-1/2 Digit

■ **5 Current Ranges:** 20 μ A, 200 μ A, 2 mA, 20 mA, 200 mA

■ **Input/Output Edge Connector**

■ **3-1/2 Digit, 0.56" Red LED Display (2865/2866) or Orange LED Display (2867/2868)**

■ **Jumper Selectable Decimal Point**

■ **Models 2865/2867 Require 120 VAC Power Supply**

■ **Models 2866/2868 Require 5 VDC Power Supply**

■ **Optional 234 VAC Power Supply**

■ **Additional Rear Terminal Connector Available**

■ **Optional Cutout Adapters**

■ **Optional "U" Shaped Mounting Bracket**

■ **Optional Display Hold**

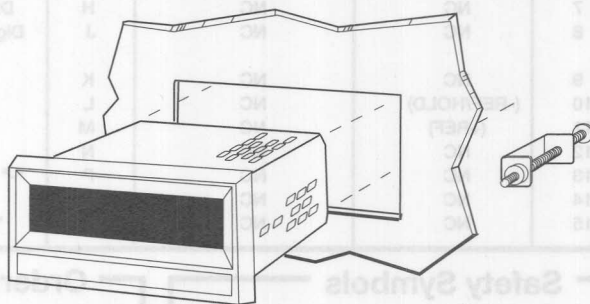
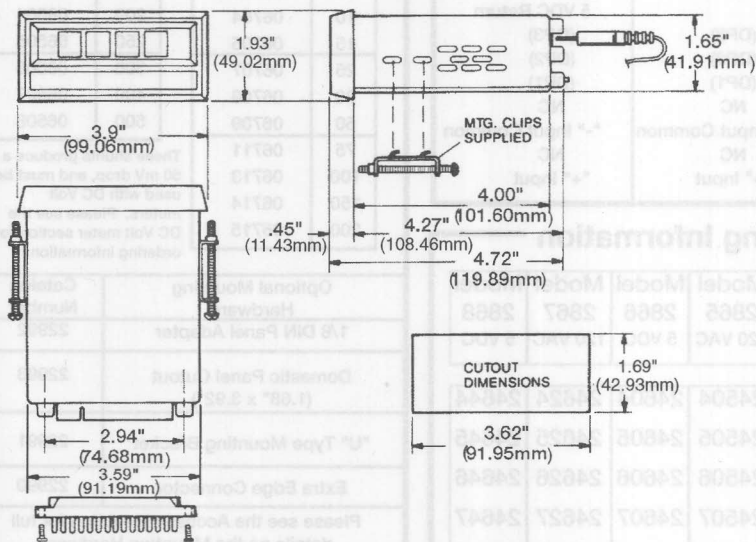


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Simpson's 2865, 2866, 2867 and 2868 Series meters offer high accuracy with high reliability. Models 2865 and 2866 have a red LED display. Models 2867 and 2868 have an orange LED display. Models 2865 and 2867 require a 120 VAC input at 50-400 Hz, and models 2866 and 2868 require a 5 VDC input at 200 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service

Centers. The large 3-1/2 digit display (0.56" high) is easily readable from a distance (about 25 feet). Panel cutout adapters are available for 1/8 DIN panel cutouts, and for older "Nema" sized cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied).

Installation and Panel Cutout



Mounting Instructions

The 2865, 2866, 2867, and 2868 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal point: 2865 / 66 Fixed with Range
2867 / 68 Jumper Selectable

Overrange indication: All digits blank except "1" above 1999 counts

POWER REQUIREMENTS

AC Voltages: 120 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA
220 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA

DC Voltages: 5 V, $\pm 5\%$ at 200 mA

Rated Circuit to Ground Voltage: 250 VDC (Model 2865/2867) or -4.06 to +4.5 VDC (Model 2866/2868)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$

$\pm 0.1\%$ of input + 5 counts (45 Hz to 1 KHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -40 to 60 °C

Relative Humidity: 0 to 85%, non-condensing

Temp. Coefficient: $\pm 0.01\%$ of input + 0.05 count / °C

Warmup time: Less than 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope

Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)

Depth: 4.27" (109mm)

Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: DC Current

Range	Display Resolution	Maximum Input
20 μA	10 nA	20 mA
200 μA	100 nA	20 mA
2 mA	1 mA	20 mA
20 mA	10 μA	100 mA
200 mA	100 μA	1 A

Voltage Drop on all ranges = 200 mV

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions.

They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

By shorting Pin 10 to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This optional feature is available from the factory or from one of our Authorized Service Centers, and must be specified

when ordering the meter. This option is not available on 2866 or 2868.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin J. The "+" VDC is connected to Pin #4.

Signal Input

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

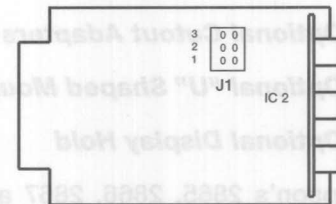
Remote Decimal Point

Remote Decimal Point selection is available from our factory or an Authorized Service Center as an option, allowing you to move the decimal point through terminal connections on the edge connector. This feature can be ordered with the unit, or it can be equipped after purchase through one of our Authorized Service Centers.

Jumper Decimal Point

The Decimal Point can be changed by moving Jumper J1 inside the 2867 / 68. The meter must be disassembled. Remove the Edge Connector first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
1	100.0
2	10.00
3	1.000



Accessories

External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunts provide a DCmV drop which is sent to the display unit.

Each shunt includes 5' leads (0.065 Ω resistance) with an accuracy is 1%.

Portable Shunts

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

These shunts produce a 50 mV drop, and must be used with DC Volt meters. Please see the DC Volt meter section for ordering information.

Optional Mounting Hardware

Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Extra Edge Connector	22990

Please see the Accessory section for full details on the Mounting Hardware

Pin Number	2865/2867 Circuit	2866/2868 Circuit	Pin Number	2865/2867 Circuit	2866/2868 Circuit
1	3rd wire GND	NC	A	3rd wire GND	NC
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	NC	NC	H	DP Common	DP Common
8	NC	NC	J	Digital Common	Digital Common/ 5 VDC Return
9	NC	NC	K	(DP3)	(DP3)
10	(-REF/HOLD)	NC	L	(DP2)	(DP2)
11	(+REF)	NC	M	(DP1)	(DP1)
12	NC	NC	N	NC	NC
13	NC	NC	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Safety Symbols

WARNING

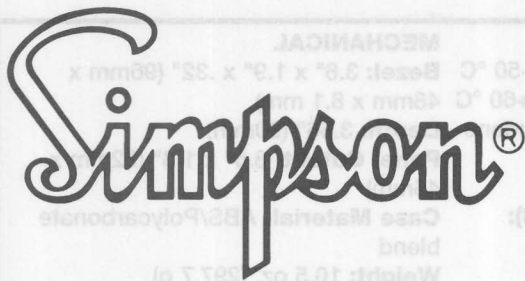
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model 2865 120 VAC	Model 2866 5 VDC	Model 2867 120 VAC	Model 2868 5 VDC
20 μA	24504	24604	24624	24644
200 μA	24505	24605	24625	24645
2 mA	24506	24606	24626	24646
20 mA	24507	24607	24627	24647
200 mA	24508	24608	24628	24648



DC Current Controllers

HAWK II

Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- Easily Programmed from the Front Panel
- User Friendly Software Functions Include:
 Password
 Display Scaling
 Decimal Point Selection
 Zero, One, or Two Setpoints
 Peak-Valley Values
 Time Delay & Hysteresis
- Screw Terminal Connector for Easy Installation
- 1/8 DIN, Shallow Depth case,
 3.5" (89mm) for Restricted Space Behind Panel
- Nema 4 / IP 65 Front Panel
- 6 DC Current Ranges: 200 μ A, 2 mA, 20 mA, 200 mA, 2 A, 5 A
- Optional 5 Amp Relay Outputs,
 Excitation Outputs, and Analog Outputs



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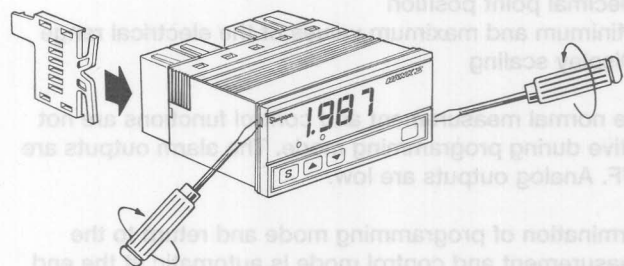
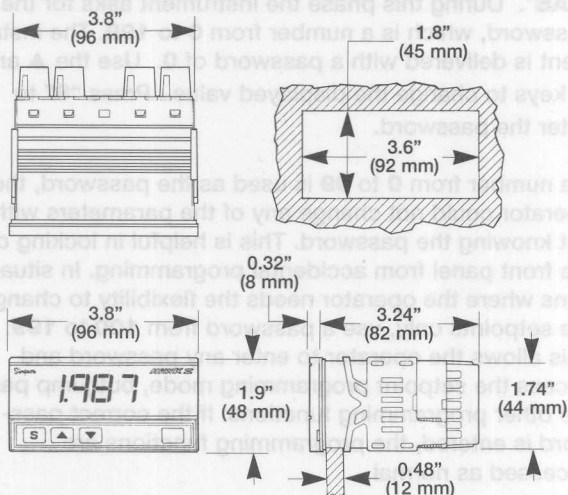
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.

Depending on the password value chosen the customer may lock out all changes, or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided.

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 3 position software programmable from front panel.

Overrange: Display reads "EE".

Underrange: Display reads "-EE".

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230

VAC, ±10% **DC Voltages:** Future

Availability

Power Consumption: 6 VA

ACCURACY:

± 0.2% ± 2 digits

Except 5 A units are ±0.5% ± 2 digits

ENVIRONMENTAL

Operating Temperature: 0°C to +50 °C

Storage Temperature: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 23°C

Temperature Coefficient (per °C):

±100 ppm/ °C

±0.05 dgt/ °C

Except 5 A units are ± 200 PPM / °C

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 Ω

CMRR: 100 dB, GR = 1 KΩ

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32" (96mm x 48mm x 8.1 mm)

Depth: 3.56" (90mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

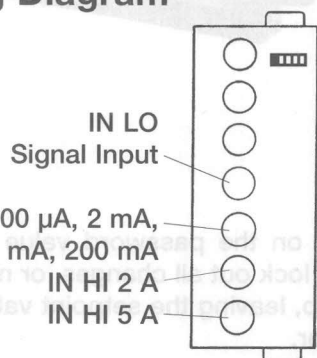
Case Material: ABS/Polycarbonate blend

Weight: 10.5 oz. (297.7 g)

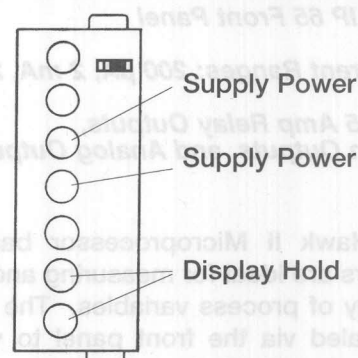
Input: DC Current

Input Range	Display Resolution	Maximum Input	Voltage Drop
200 µA	100 nA	20 mA	200 mV
2 mA	1 µA	20 mA	200 mV
20 mA	10 µA	100 mA	200 mV
200 mA	100 µA	500 mA	200 mV
2 A	1 mA	2.2 A	200 mV

Wiring Diagram



Input Signal: connect the signal to be monitored to the **IN HI** and the **IN LO** terminals. Note that the **IN HI** signal has three terminals that can be used, depending on the amount of Current being monitored. The upper **IN HI** terminal accepts 0.2, 2, 20, and 200 mA inputs. The middle **IN HI** terminal accepts the 2 A input. The lower **IN HI** terminal accepts the 5 A input.



Supply Power: Connect the power to the input power terminals.
Display Hold: Short the terminals marked **HOLD** to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End"

Access to programming

Press the "**S**" key and the **▲**. The display should show "**PAS**". During this phase the instrument asks for the password, which is a number from **0** to **199**. The instrument is delivered with a password of **0**. Use the **▲** and **▼** keys to change the displayed value. Press "**S**" to enter the password.

If a number from **0** to **99** is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from **100** to **199**. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

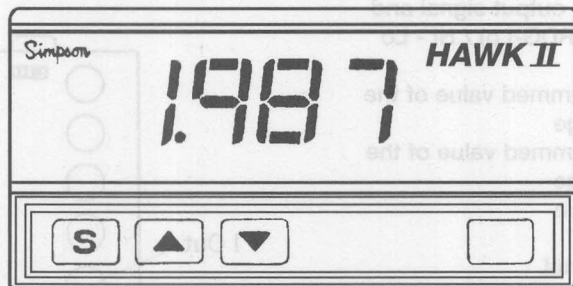
Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from **0** to **199**. Press "S" to move to the next parameter.

Decimal Point Selection

The display will show "**dP**" for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the ▲ and ▼ keys. Press "S" to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the "S" key. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The Display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (**LOE** to **HiE**)

Programmed display span: 0 to 100% (**LO** to **Hi**)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show "**Hi**" for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the ▲ and ▼ keys to change the displayed value. The maximum is **+1999**. Press the "S" key when the correct value is displayed.

The display will show "**LO**" signifying the minimum of the display span. The display shows the value stored in memory. To modify the value, use the ▲ and ▼ keys. The value can be as low as **-1999** in the DC Current meter. Press the "S" key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the Programming the Relays section.

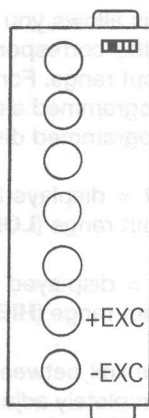
$$\left| \frac{\text{HiE} - \text{LOE}}{\text{Hi} - \text{LO}} \right| \pm 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

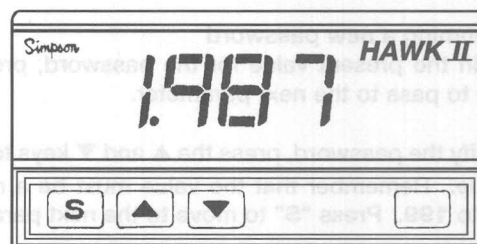
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Insulating voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo)+4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

0-1 VDC Output signal

Relationship between output signal and displayed value: $V = (RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-10 VDC Output signal

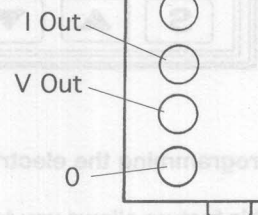
Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-1 V	Output 0-10 V
Overrange	EE	20 mA	1 V	10 V
Underrange	- EE	4 mA	0 V	0 V

NOTE:

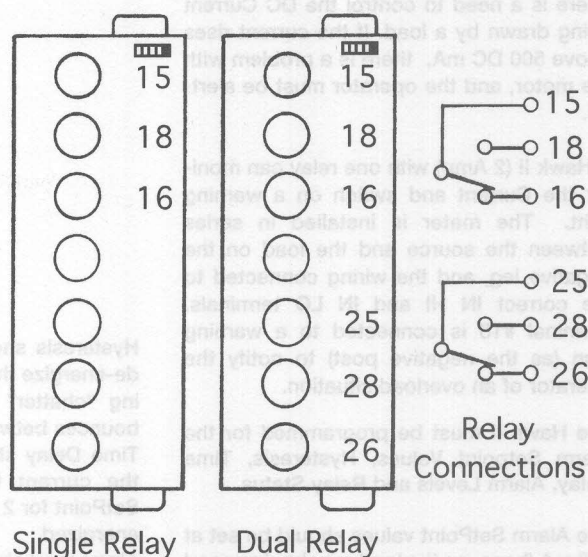
Analog output is not available in conjunction with Excitation

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ C	500 Ohm	N/A	Yes
0-1 V	±1% ±0.005V	±200 ppm/ C	N/A	≤ 3 Ohm	Yes
0-10 V	±1% ±0.05V	±200 ppm/ C	N/A	≤ 3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the set points.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **HI** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate "chatter" in the relays. The value is selected from 1 to 1999 counts.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the Setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the Setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm; Normally Energized, or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed, and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

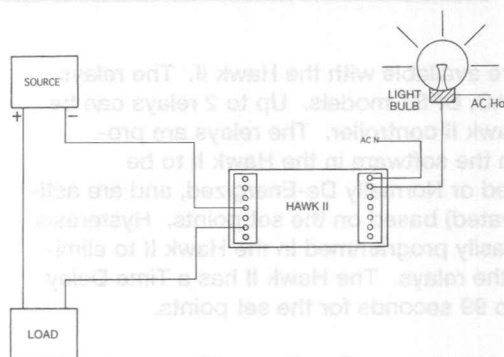
Application Example

There is a need to control the DC Current being drawn by a load. If the current rises above 500 DC mA, there is a problem with the motor, and the operator must be alerted.

A Hawk II (2 Amp) with one relay can monitor the Current and switch on a warning light. The meter is installed in series between the source and the load on the negative leg, and the wiring connected to the correct IN HI and IN LO terminals. Terminal #18 is connected to a warning sign (as the negative post) to notify the operator of an overload situation.

The Hawk II must be programmed for the Alarm Setpoint Values, Hysteresis, Time Delay, Alarm Levels and Relay Status.

The Alarm SetPoint values should be set at 499 mA (because the load may be damaged if it stays on line).



Hysteresis should be set at 10. This will de-energize the relay at 489 mA, eliminating "chatter" in the relay if the signal bounces between 500 mA and 499 mA. Time Delay should be set at 2, allowing the current to rise above the Alarm SetPoint for 2 seconds before the relay is energized. Alarm level should be set for up ("uP") so that the relay is energized when the cur-

rent rises above the Alarm Setpoint.

Relay Status is normally de-energized (nd), indicating the status of the relay in the absence of an alarm situation.

The display on the Hawk II can be easily scaled. Simply set the HiE, LOE, HI and LO values in the programming mode.

Ordering Information

Basic Unit		Output Signal		Excitation	
H235	3-1/2 Basic Unit	0	None	0	None
		1	4-20 mA	1	12 VDC
		2	0-1 V	2	24 VDC
		3	0-10 V		
Power Supply		Function/Range		Number of Relays	
1	120 VAC	0110	200 mV	0	None
2	220 VAC	0210	200 μ A	1	One
3	24 VAC	0220	2 mA	2	Two
4	48 VAC	0230	20 mA		
		0240	200 mA		
		0250	2 A		
		0260	5 A		

Safety Symbols

WARNING

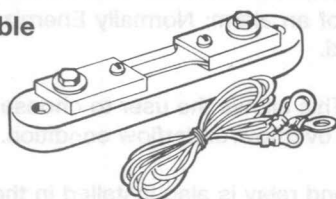
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

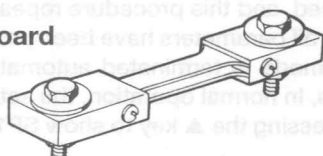
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Portable



Switchboard



External shunts enable digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Hawk II can be scaled to display the actual Current load between the load and the source. Simpson manufactures Portable and Switchboard Shunts. These shunts must be used with a millivolt meter.

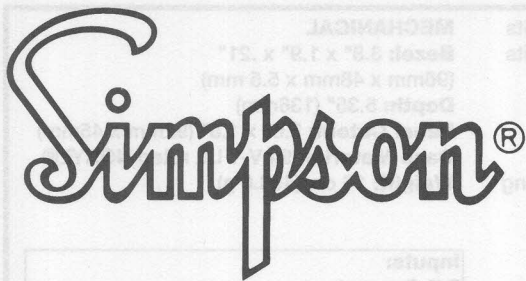
Each shunt includes 5' leads.

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Controllers

Hawk HK35 & HK45 Series 3-1/2 & 4-1/2 Digit

- Easily Programmed From the Front Panel
- Software Functions Include:
 - Password
 - One, or Two Setpoints
 - Time Delay & Hysteresis
 - Display Scaling
 - Decimal Point Selection
- 3-1/2 or 4-1/2 Digit, Bright Red Display
0.56" (14.2 mm) High
- Display Hold
- 2 Piece Screw Terminal Connector
- 1/8 DIN Case, Made of High Impact Noryl®
- 5 DC Current Ranges: 200 μ A, 2 mA, 20 mA,
200 mA, 2 A
- Optional Nema 4 Front Panel Cover
- Optional 5 Amp Relays and Analog/Digital Outputs



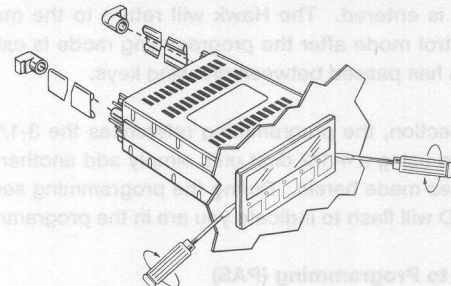
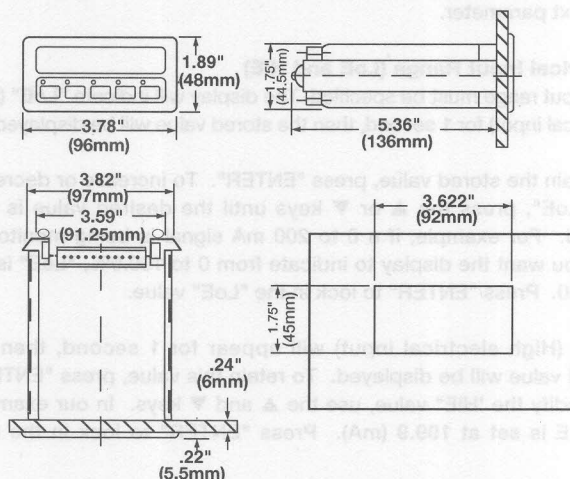
Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Optional Peak Hold is available to replace the standard Display Hold, allowing the Operator to observe peak values in the input signal.

Two optional 5 Amp Relays include front panel programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include programmable decimal point and a password lockout

feature. By using the password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 5.35" (136mm). The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash-down environments. A 2 piece screw terminal connector is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

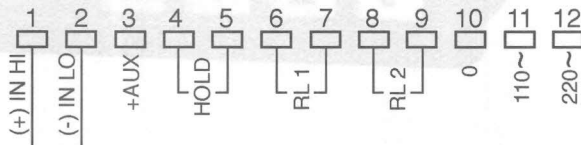
Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

ACCURACY @ 25° C**HK35:** 0.10% of input ± 1 digit (2 A: ± 5 digits)**HK45:** 0.05% of input ± 1 digit (2 A: ± 5 digits)**Rate:****HK 35:** 4 times per second**HK 45:** 2 times per second

200 mA 2 A	100 μ A 1 mA	10 μ A 100 μ A	400 mA 2.4 A	250 mV 250 mV
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Wiring Diagram

**Input Signal:**

Connect the input signal to the IN HI and the IN LO terminals (#1 and #2).

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller.

The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals. Not available in conjunction with Peak Hold.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Setpoint values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "**PAS**" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2"

LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "**dP**" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "**LoE**" (Low electrical input) for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. For example, if a 0 to 200 mA signal is being monitored, and you want the display to indicate from 0 to 100.0%, "LoE" is set for 0.00. Press "ENTER" to lock in the "LoE" value.

"**HiE**" (High electrical input) will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the $\blacktriangle$ and $\blacktriangledown$ keys. In our example, the HiE is set at 199.9 (mA). Press "ENTER" to lock in the new value.

Programming cont.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values from shunts or transformers. For example:

Electrical Input Range : 0 to 199.9 (LoE to HiE)

Programmed Display Scaling: 0 to 100.0 (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. In our example, the Hi is 100.0. The controller will display 100.0% when 199.9 mA is being monitored. Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press

"ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-energized ("nd"). Press "ENTER" to store desired setting.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

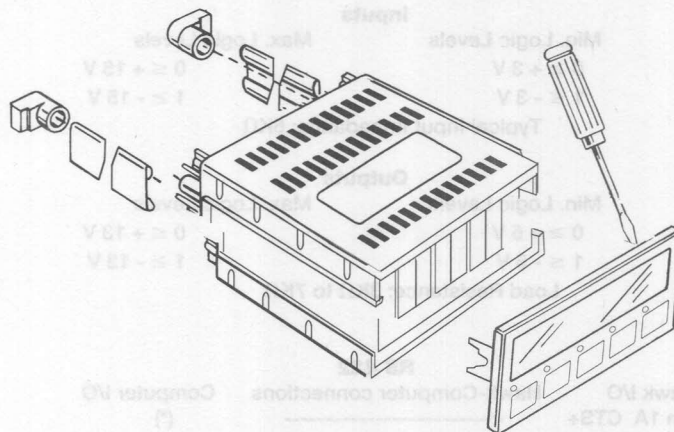
Exiting Programming Mode

After programming the relay(s), the Hawk will automatically exit the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it on to the case. Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the "O" rings on the back and the bezel on the front.

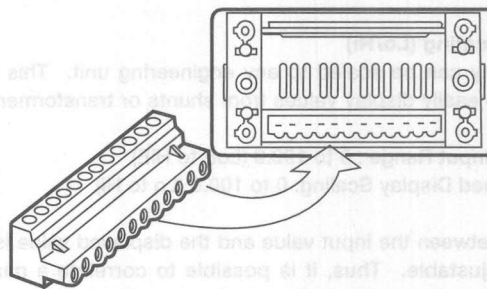


2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up. Extra connectors are available from your Authorized Hawk distributor.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

RS232C

Inputs	
Min. Logic Levels	Max. Logic Levels
$0 \geq +3V$	$0 \leq +15V$
$1 \leq -3V$	$1 \geq -15V$
Typical Input Impedance: 5K Ω	

Outputs	
Min. Logic Levels	Max. Logic Levels
$0 \geq +5V$	$0 \leq +13V$
$1 \leq -5V$	$1 \geq -13V$
Load Resistance: 3K Ω to 7K Ω	

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<-----	SG

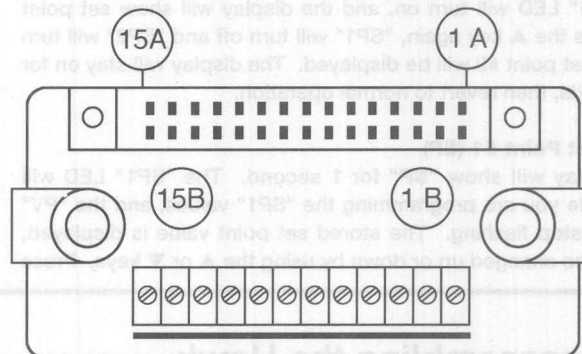
Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2V$ (diff)	$0 \leq +12V$ (diff)
$1 \leq -0.2V$ (diff)	$1 \geq -12V$ (diff)

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5V$ (diff)	$0 \leq +5V$ (diff)
$1 \leq -1.5V$ (diff)	$1 \geq -5V$ (diff)
Termination Resistances : 100 $\Omega \pm 10\%$	

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.



CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

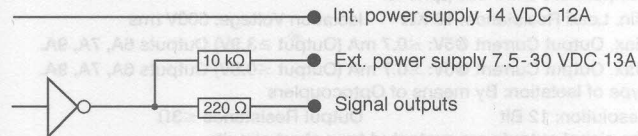
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(1sd)	2nd digit	3rd digit	4th digit	5th digit(msd)
Value Pin	Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B	*10,000 5A
2 2B	20 2A	200 6B	*2,000 10B	
4 3B	40 3A	400 7B	*4,000 11B	
8 4B	80 4A	800 8B	*8,000 12B	

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mADC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for DC Current controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points for the output signal.

Analog Output	Out +	Out -
4-20 mADC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminal connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mADC:

$$I = (16/Hi - Lo) \times (RDG - Lo) + 4$$

I = Output Current (mA)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C (HK 35)

Temperature Drift: ± 120 ppm/°C (HK 40 and HK 45 RTD/TC)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

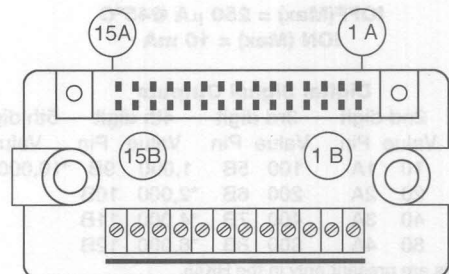
Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit

Output Resistance $\leq 3\Omega$

The signal outputs are protected from short circuits.

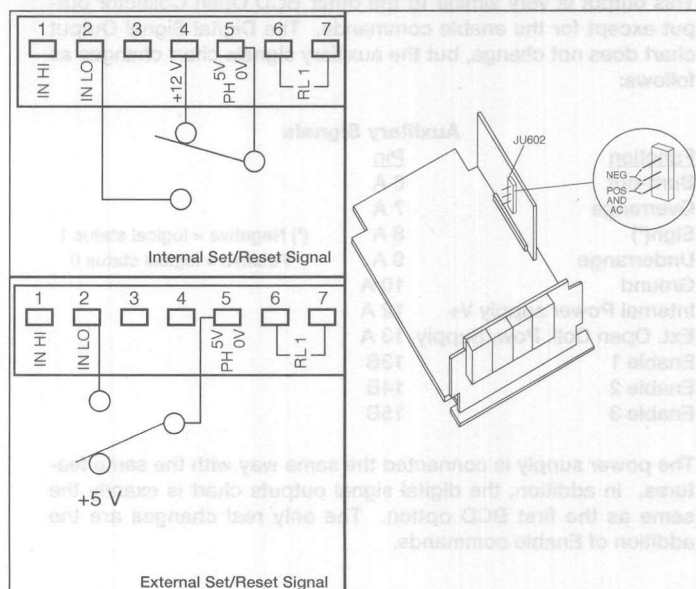


Peak Hold

The Peak Hold feature is used to display DC values, such as positive or negative Current peaks. This feature can be controlled internally or externally. The display will briefly "Hold" the peak value, and slowly "decay" to the current input signal. The decay rate is approximately 1 digit per second for the 3-1/2 digit unit, and approximately 5 digits per second for the 4-1/2 digit unit. Display Hold is not available for use when Peak Hold is ordered with the Hawk because the two features use the same terminal contacts.

To measure peak values, apply zero volts DC to the Peak Hold input (terminal #5) by connecting terminal #5 to terminal #2. To clear the reading using the internal source, apply a minimum of 5 VDC through a maximum of 12 VDC to terminal #5. This can be accomplished by connecting terminal #4 to #5. To clear the reading using an external source, connect terminal #5 to an external reference.

The controller can be used to capture Negative Voltage/Current Peaks. Disassemble the unit and move the programmable jumper (JU602) to the next position as illustrated in the right diagram.



Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels correspond to the setpoint values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart below shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,
4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

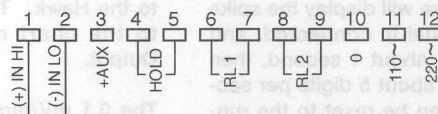
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals #6 and #7, and relay #2 is wired from terminals #8 and #9.



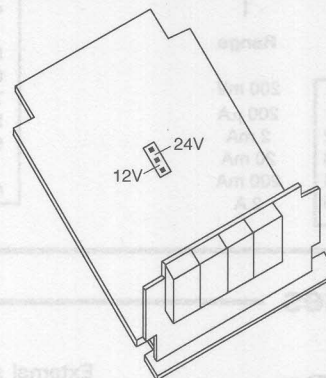
Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

Excitation Output

Excitation output is an optional feature for the Hawk Controller. 12 or 24 VDC excitation is available, preset to your specifications. The value can be changed in the field by moving the jumper on the main board (see diagram).

The Excitation output eliminates the need to set up expensive DC power supplies for external transmitters and transducers that can be used with the Hawk. The 12 Volt output supplies 30 mA maximum, and the 24 Volt output supplies 25 mA maximum.

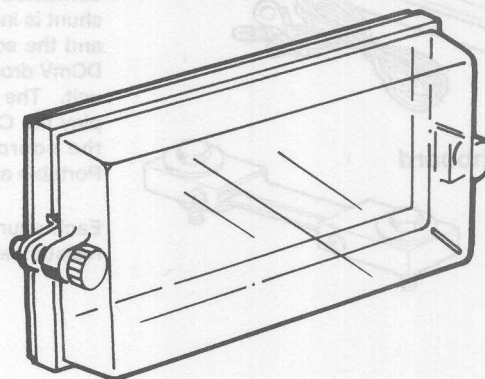
Please specify when ordering which value you need. The controller can be retrofitted with Excitation through the Factory or one of our Authorized Service Centers.



NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



meter can monitor the Current draw, and will display the value with a 0.0001 Amp resolution.

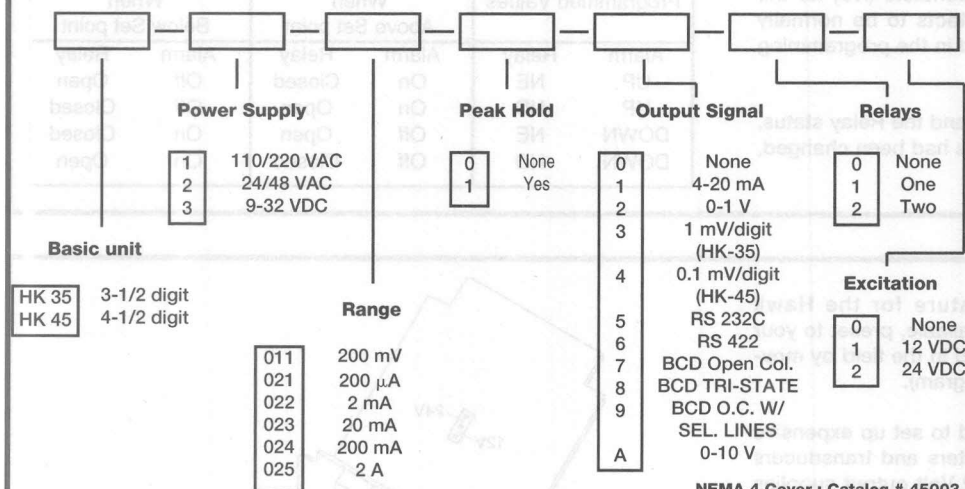
The Peak hold feature will display the spike value when the signal is connected, and hold the display for about 1 second, then decay at the rate of about 5 digits per second. The display can be reset to the run-

ning Current draw by wiring the external reset signal to a switch on the panel next to the Hawk. The peak value will be sent to the chart recorder via the Analog Output.

The 0.1 mV/digit signal can be routed to

the chart recorder. The output signal will send an increasing mV signal based on the display. The chart paper can be marked to indicate specified values, and notation made for the serial number of the motor being tested.

Ordering Information



Safety Symbols

WARNING

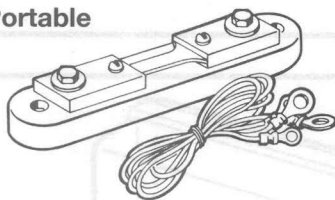
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

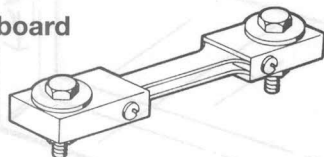
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

Portable



Switchboard



External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Hawk can be scaled to display the Current between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

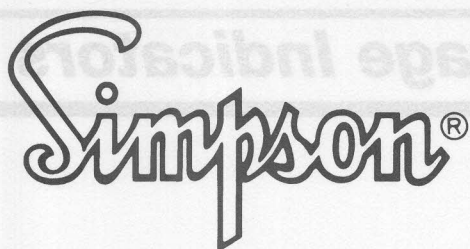
Each shunt includes 5' leads (0.065 Ω resistance). Accuracy is 1%.

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Voltage Indicators

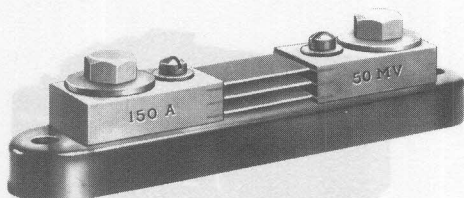


From compact 3/64 DIN mini indicators to 1/8 DIN controllers, Simpson offers a wide range of digital meters to fit your application requirements.

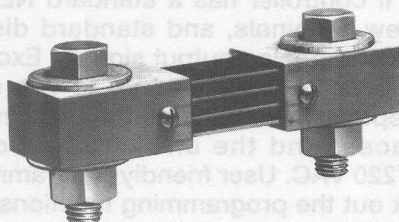
Panel Cutout and Displays

Simpson's line of DC Voltage indicators/controllers are available in 3 different panel cutout sizes. The Mini and Mini-Max indicators are 3/64 DIN, offering compact size with a large 0.5" LCD display. An optional negative image, red backlit LCD display is available for all the Mini and Mini-Max indicators. The Falcon indicators and Hawk/Hawk II controllers are 1/8 DIN size, and both styles have 0.56" red LED displays. The 2800 series indicators require a 92mm by 42.72 mm cutout, and offer the same 0.56" red LED display. The 2867 and 2868 indicators offer an optional orange LED display, allowing easier viewing in darker areas.

Portable Shunt



Switchboard Shunt



Shunts

All of the digital DC Voltage indicators Simpson manufactures offer a 200 mV range, which allows you to use portable and switchboard shunts. The shunt is used to monitor a high current signal, much higher than could be handled direct by a meter. The shunt emits a 50 mV signal, and thus is used with a 200 mV meter.

Portable shunts range from 1 amp up to 200 amps, and have a phenolic base. This allows the shunt to be mounted in various locations. Switchboard shunts do not have the phenolic base, and need to be mounted to a switchboard location. Both types of shunts include 5" long lead wire to connect the shunt to the meter.

Power Supply

Most units feature 120/220 VAC power supply. The 2800 series has an optional 5 VDC power supply, and the Mini-Max offers choice of 12/24/48 VDC power supply. The Falcon indicators and Hawk controllers have optional 9-32 VDC power supply, and the Hawk/Hawk II controllers have an optional 24/48 VAC power supply.

Display Hold

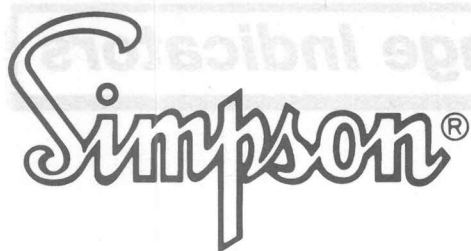
Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the DC Voltage signal.

Relays, Analog and Digital Outputs

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in either the Hawk or Hawk II controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are available in both the Hawk and Hawk II controllers. The Hawk II has Analog output signals (4-20 mA, 0-1 V, and 0-10 V signals). The Hawk offers Analog or Digital output signals, such as RS 232/RS 422, as well as BCD output signals.

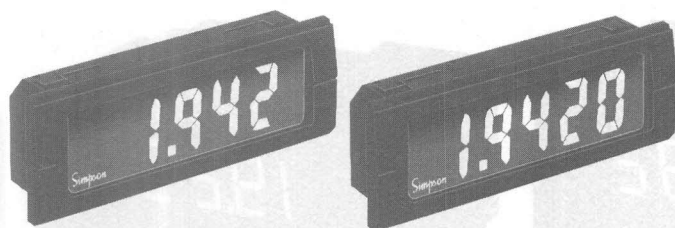
Excitation

Excitation output is available in the Mini-Max and Falcon indicators, and in the Hawk/Hawk II controllers.



DC Voltage Indicators

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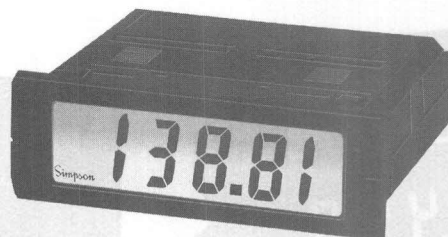
With a 3/64 DIN cutout, and 12 mm depth, Mini meters from Simpson fit the smallest panel spaces easily. Available in 3-1/2 or 4-1/2 digit LCD, or optional negative image backlit LCD display. The mini requires 5 VDC, ± 5 VDC, or 9 VDC power supply. The Mini snaps into the panel, and does not require any mounting hardware. 12 pin mating connector with 6" lead wires is included.



The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. 3-1/2 digit or 4-1/2 digit displays are available. An optional orange LED display is available for the 3-1/2 digit unit. Jumper selectable decimal point allows field flexibility of this meter in your application.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include dual relays, and Analog/Digital output signals. Excitation output (12 VDC or 24 VDC) is available for powering transmitters and other accessories. An optional 9-32 DC power supply is available for the Hawk controller.



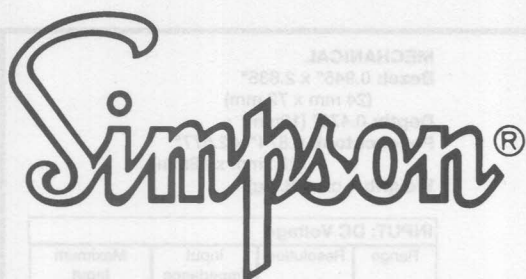
With a 3/64 DIN cutout and 60 mm depth, Mini-Max fits small spaces easily. Available in 3-1/2 or 4-1/2 digit LCD display, and optional negative image, red backlit display. A unique mounting bracket allows easy stacking of multiple units in one panel cutout, eliminating the need to tap multiple holes. Screw terminals are standard for easy wiring installation.



Falcon F35 and F45 indicators are low cost indicators that can monitor 200 mV through 750 Volts. These units offer broad range scaling to any engineering unit. The Falcon series can be modified in the field to accept a different range by moving selected jumpers on the main board. Excitation output (12 VDC or 24 VDC) is available in both the F35 and F45 indicators.



The Hawk II controller has a standard NEMA 4 front panel, screw terminals, and standard display hold. Options include Analog output signals, Excitation output (12 VDC or 24 VDC), and up to two relays. The shallow depth allows easy installation in restricted panel spaces, and the unit can be powered by 24/48/120/220 VAC. User friendly programming allows you to lock out the programming functions with password protection.



DC Voltage Indicators

MINI M135 Series 3-1/2 Digit

- **Minimum Depth Indicator! Less than 0.5" (12.7 mm) of Space Required Behind the Panel!**
- **Fits 3/64 DIN Standard Cutout, 22.2 mm x 68 mm**
- **3-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Optional Negative Image, Bright Red Backlighting**
- **12 Pin Mating Connector With 6" Lead Wires Included for Easy Installation**
- **Display Hold Standard on All Units**
- **4 Voltage Ranges: 200 mV, 2 V, 20 V, 200 V**
- **3 Power Supply Alternatives: 5 VDC, ± 5 VDC, or 9 V Battery (With Low Battery Indication)**



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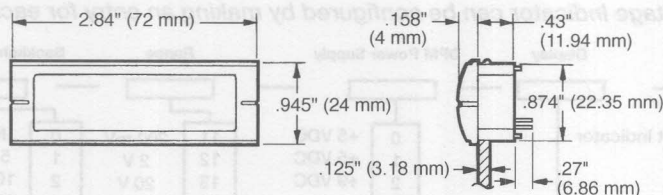
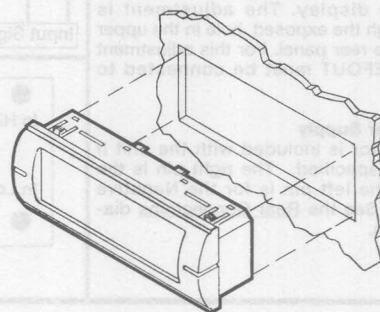
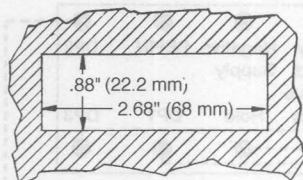
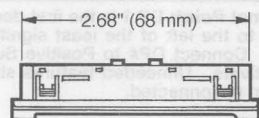
Simpson's Mini DC Voltage Indicators provide high quality, accuracy and reliability in a compact 12 mm deep case. The M135 has a 3-1/2 digit, 0.5" LCD display and is available with a negative image, bright red backlight option. Mini M135 meters feature user selectable decimal point and display hold.

Three power supply choices are available, and a low

battery indication is provided for 9 V battery applications.

Mini units feature a standard 3/64 DIN high impact plastic case. The negative image, bright red backlit units have a red window, and the non-backlit units have a clear viewing window.

Installation and Panel Cutout



*No mounting hardware required, snaps right into panel!

Mounting Requirements

The Mini indicators require a panel cutout of 2.68" (68mm) wide by 0.88" (22mm) high, and a panel area of 0.945" (24mm) high by 2.84" (72mm) wide. The depth behind the panel, including terminals, is 0.7" (17.8mm). The front bezel protrudes 0.158" (4mm) from the front of the mounting surface. The unit will snap mount into panels from 0.050" to 0.125" thick. A 12 pin connector with 6" wire leads is included with each unit for quick installation.

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

A reversed polarity power supply will permanently damage this instrument.

CAUTION

IN Low must remain within the limits of the power supply.

A positive reading will be displayed when IN Hi is more positive than IN Low.

Internal Reference: REFOUT must always be connected to REFIN unless an external reference is being used.

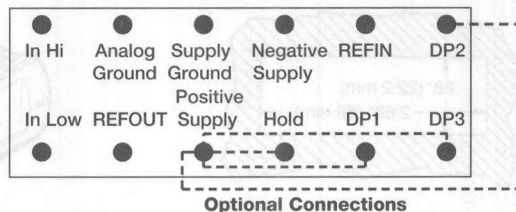
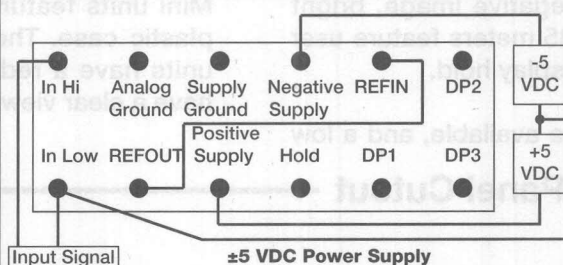
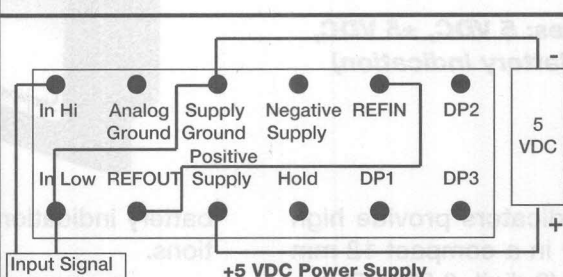
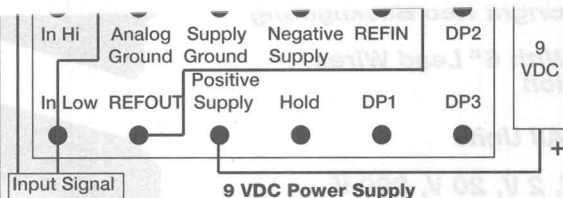
External Reference: Connect between REFIN and ANALOG GROUND; REFOUT should then be unconnected (open). For best results, external reference voltage should be in the range of 50 mV to 150 mV. System stability is then only as good as the external reference.

Calibration, Scaling and Offset

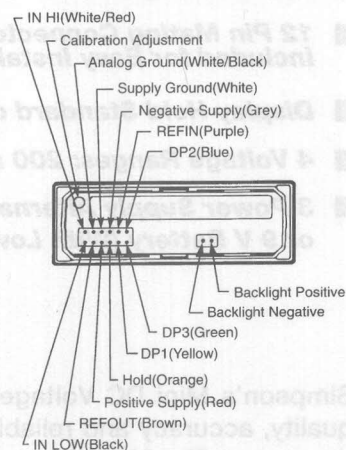
Model M135 has a limited range adjustment for calibration. Apply the appropriate Voltage input for a near full scale reading, typically 1900 counts on the display. The adjustment is accessed through the exposed hole in the upper left corner of the rear panel. For this adjustment to function, REFOUT must be connected to REFIN.

Backlight Power Supply

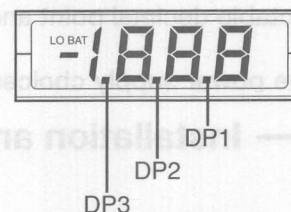
A 2 pin connector is included with the unit if backlighting is specified. The right pin is the Positive, and the left pin is for the Negative power supply. See the Rear Connections diagram for location.



Rear Connections



Decimal Point



Decimal Point: DP 1 is the first decimal point to the left of the least significant digit. Connect DP# to Positive Supply to activate. Unneeded features should remain unconnected.

Display Hold: The display can be held indefinitely by connecting Hold to Positive Supply. The display will function normally when this connection is removed.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Your Mini Voltage Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Backlight Power
M135	3-1/2 Digit Indicator	0 +5 VDC 1 ±5 VDC 2 +9 VDC	11 200 mV 12 2 V 13 20 V 14 200 V	0 None 1 5 VDC 2 10 VDC 3 12 VDC 4 24 VDC 5 48 VDC
	0 Non Backlight 1 Negative Image Red			



DC Voltage Indicators

MINI M145 Series 4-1/2 Digit

- **Minimum Depth Indicator! Less than 0.5" (12.7 mm) of Space Required Behind the Panel!**
- **Fits 3/64 DIN Standard Cutout, 22.2 mm x 68 mm**
- **4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Optional Negative Image, Bright Red Backlighting**
- **12 Pin Mating Connector With 6" Lead Wires Included for Easy Installation**
- **Display Hold Standard on All Units**
- **4 Voltage Ranges: 200 mV, 2 V, 20 V, 200 V**
- **3 Power Supply Alternatives: 5 VDC, ± 5 VDC, or 9 V Battery (With Low Battery Indication)**
- **Broad Range Display Scaling**



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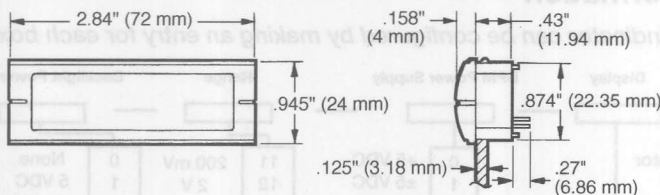
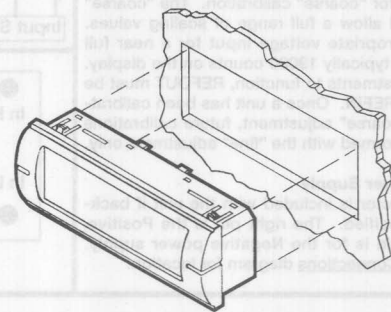
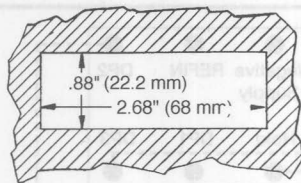
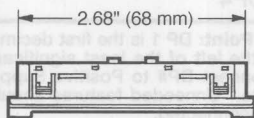
Simpson's new Mini DC Voltage Indicators provide high quality, accuracy and reliability in a compact 12 mm deep case. M145 has a 4-1/2 digit, 0.5" LCD display and is available with a negative image, bright red backlight option. Mini M145's feature user selectable decimal point and display hold.

battery indication is provided for 9 V battery applications.

Mini units feature a standard 3/64 DIN high impact plastic case. The negative image, bright red backlight units have a red window, and the non-backlight units have a clear viewing window.

Three power supply choices are available, and a low

Installation and Panel Cutout



*No mounting hardware required, snaps right into panel!

Mounting Requirements

The Mini indicators require a panel cutout of 2.68" (68mm) wide by 0.88" (22mm) high, and a panel area of 0.945" (24mm) high by 2.84" (72mm) wide. The depth behind the panel, including terminals, is 0.7" (17.8mm). The front bezel protrudes 0.158" (4mm) from the front of the mounting surface. The unit will snap mount into panels from 0.050" to 0.125" thick. A 12 pin connector with 6" wire leads is included with each unit for quick installation.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 4 position programmable

Overrange indication: Most significant = "1"

Backlighting: Optional negative image, red LED backlighting at 5, 10, 12, 24, or 48 VDC

POWER REQUIREMENTS

DC Power: ± 5 V, $+5$ V, and $+9$ V

(Low battery indication provided with 9 V units)

Power supply current: 2 mA max

Backlight supply current: 50 mA typical

For 24 and 48 VDC, 10 mA typical

ACCURACY @ 25°C: $\pm(0.04\%$ of reading + 1 count)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60 °C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient: (All inputs) $\pm(0.02\%$ of input ± 0.2 digit) / °C

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (with 1 K Ω unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.945" x 2.835"

(24 mm x 72 mm)

Depth: 0.473" (12mm)

Panel cutout: 0.874" x 2.677"

(22.2mm x 68mm)

Weight: 1 oz. (28.3 g)

INPUT: DC Voltage

Range	Resolution	Input Impedance	Maximum Input
200 mV	10 μ V	>100M Ω	50 V
2 V	100 μ V	>100M Ω	50 V
20 V	1 mV	10M Ω	250 V
200 V	10 mV	10M Ω	250 V

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

A reversed polarity power supply will permanently damage this instrument.

CAUTION

IN Low must remain within the limits of the power supply.

A positive reading will be displayed when IN Hi is more positive than IN Low.

Internal Reference: REFOUT must always be connected to REFIN unless an external reference is being used.

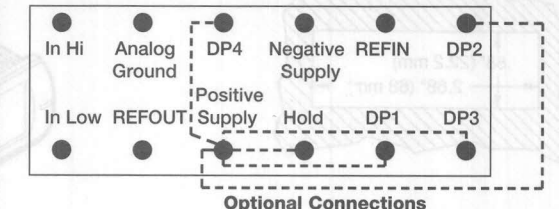
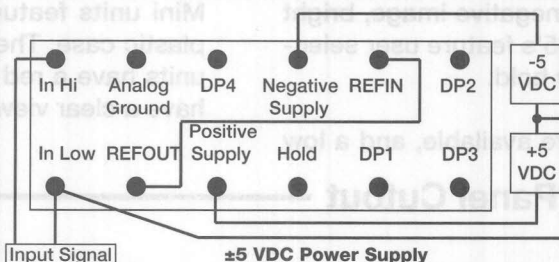
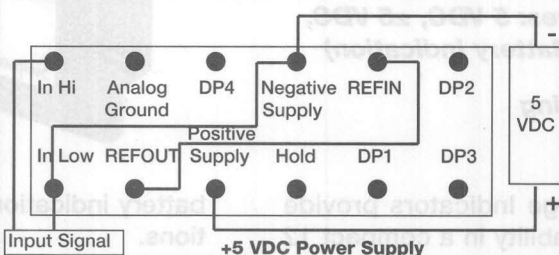
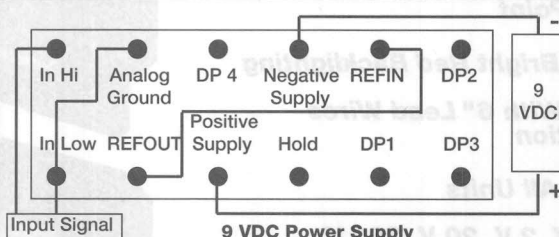
External Reference: Connect between REFIN and ANALOG GROUND; REFOUT should then be unconnected (open). For best results, external reference voltage should be in the range of .5 V to 1.5 V. System stability is then only as good as the external reference.

Calibration, Scaling and Offset

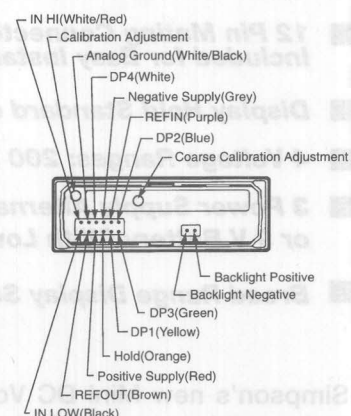
Model M145 has two internal scaling adjustments on the rear panel, one that is covered by a label, and one that is always exposed. The exposed adjustment is a "fine" calibration point, and the covered adjustment is for "coarse" calibration. The "coarse" calibration will allow a full range of scaling values. Apply an appropriate voltage input for a near full scale reading, typically 19000 counts on the display. For these adjustments to function, REFOUT must be connected to REFIN. Once a unit has been calibrated with the "coarse" adjustment, future calibrations should be performed with the "fine" adjustment only.

Backlight Power Supply

A 2 pin connector is included with the unit if backlighting is specified. The right pin is the Positive, and the left pin is for the Negative power supply. See the **Rear Connections** diagram for location.



Mini M145 Rear Connections



Decimal Point



Decimal Point: DP 1 is the first decimal point to the left of the least significant digit. Connect DP# to Positive Supply to activate. Unneeded features should remain unconnected.

Display Hold: The display can be held indefinitely by connecting Hold to Positive Supply. The display will function normally when this connection is removed.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

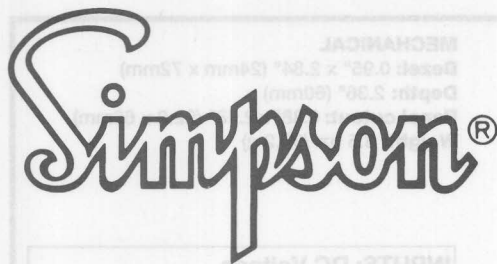
CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Your Mini Voltage Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Backlight Power
M145	4-1/2 Digit Indicator	0 +5 VDC 1 ± 5 VDC 2 +9 VDC	11 200 mV 12 2 V 13 20 V 14 200 V	0 None 1 5 VDC 2 10 VDC 3 12 VDC 4 24 VDC 5 48 VDC
	0 Non Backlight 1 Negative Image Red			

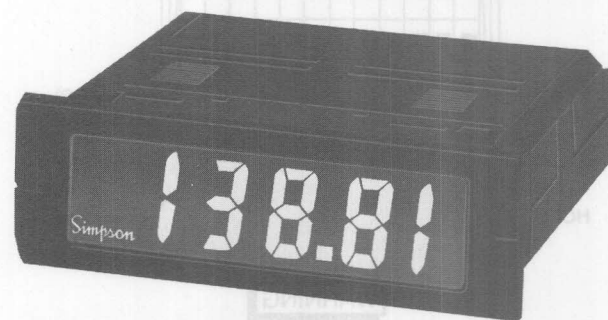


DC Voltage Indicators

MINI-MAX M235 & M245 Series 3-1/2 & 4-1/2 Digit

- **Shallow Depth Indicator! Less Than 2.5" (60 mm) of Space Required Behind the Panel**
- **Fits 3/64 DIN Standard Cutout, 22.2mm x 68mm**
- **Stackable Mounting Bracket Included for Easy Installation**
- **3-1/2 or 4-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Broad Range Display Scaling**
- **Optional Negative Image Bright Red Backlighting**
- **Standard Screw Terminals for Easy Installation**
- **5 Voltage Ranges: 200 mV, 2V, 20V, 200V, 750V**
- **120/220 VAC, or 12/24/48 VDC Isolated Power**

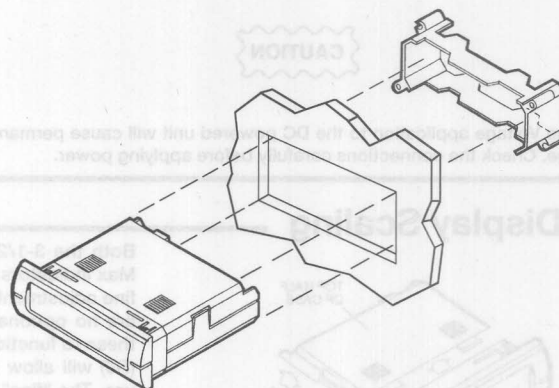
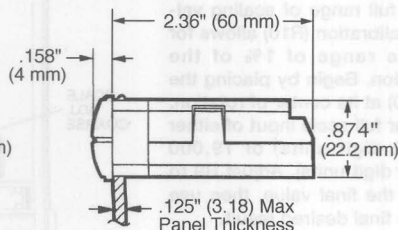
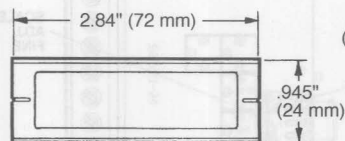
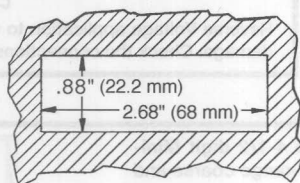
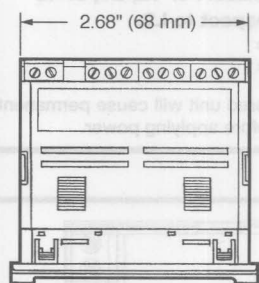
Simpson's new Mini-Max Voltage Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units offer choice of 3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, and scaling capabilities. Display hold is optionally



available for the 4-1/2 digit units. A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All Mini-Max units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.

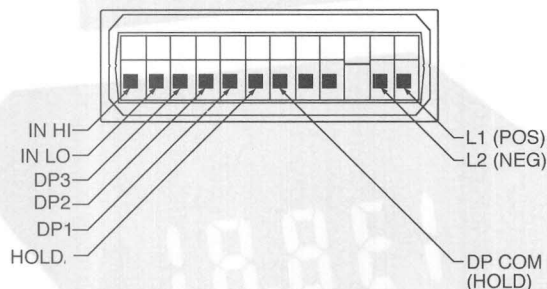
Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, or DP3) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

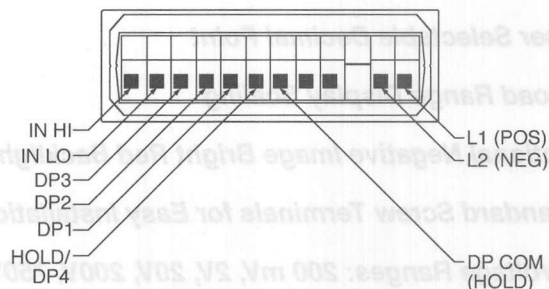
Input Signal: Connect the IN HI and IN LOW to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

M245 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, DP3, or DP 4) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open). Hold is optional with the 4-1/2 digit Mini-Max, and when so equipped replaces DP4. Available through the factory or our authorized modification centers.

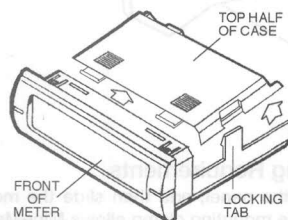
Input Signal: Connect the IN HI and IN LOW to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. **For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.**

CAUTION

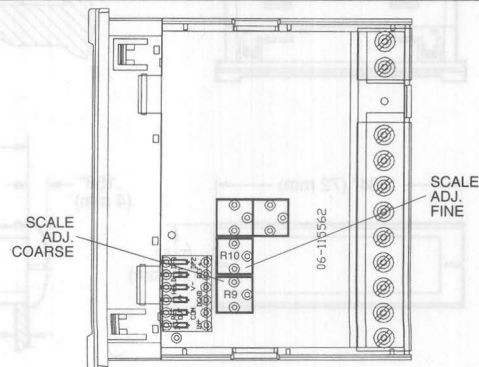
Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

Display Scaling



Using a screwdriver or thumbnail spread tab on each side of case to unlock top half. Lift rear of top half and slide away from front of meter.

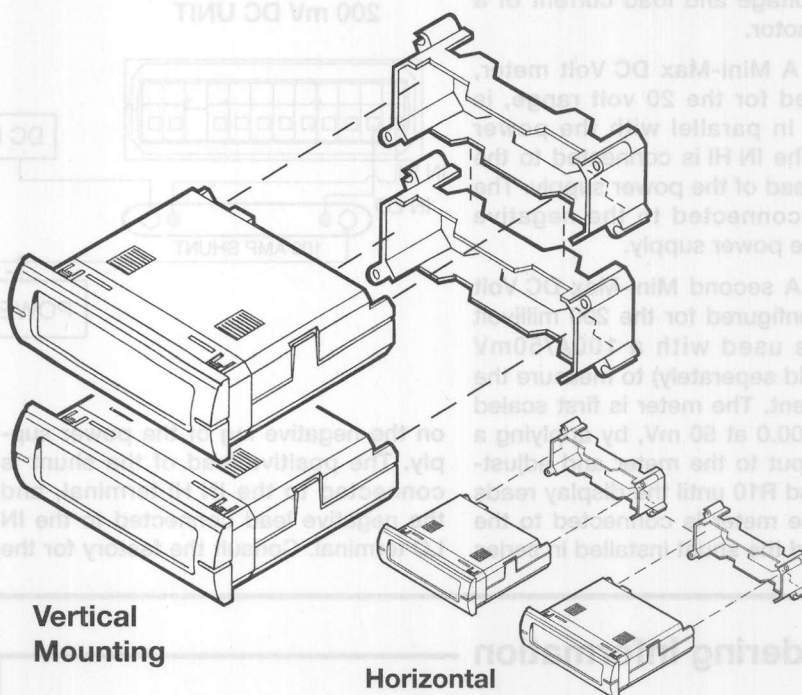
Both the 3-1/2 and the 4-1/2 digit Mini-Max indicators have full-range coarse and fine adjustments for display scaling. There are no optional connections required for these to function. The "coarse" calibration (R9) will allow a full range of scaling values. The "fine" calibration (R10) allows for an approximate range of 1% of the "coarse" calibration. Begin by placing the "fine" adjust (R10) at its center of rotation. Then apply a near full scale input of either 1,900 (for 3-1/2 digit units) or 19,000 counts (for 4-1/2 digit units). Adjust R9 to be within 1% of the final value, then use R10 to obtain the final desired result.



Stacking Features

The mounting clips that come with every Mini-Max can be connected together. This allows multiple units to be mounted in one hole (no need to punch one hole per meter). Perfect alignment in the panel can be achieved, as only one hole is made.

For DC applications, Mini-Max 2-Packs provide economical and reliable voltage and current measurement capabilities in our most popular ranges. The power requirement is 120 VAC. Mounting the two units is very simple. The bottom unit is installed first, then the mounting clip is attached to the top of the bottom unit. Finally, the top meter is installed into the top clip.

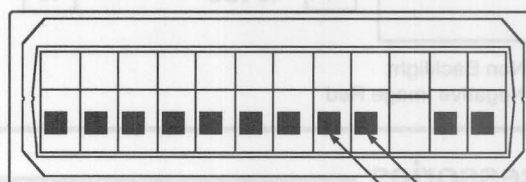


2-Pack DC Voltage/Current Indicators

Catalog No.	Voltage	Current	Backlight
M35021	2V	200 mA	None
M35022	20V	2 A	None
M35122	20V	2 A	Negative Red
M35023	200V	5 A	None
M35123	200V	5 A	Negative Red

Excitation Output

Excitation output is optionally available in the Mini-Max for powering external transmitters or transducers. Excitation is available from the EX POS and EX NEG terminals. This source is isolated from the measurement input as well as the input power circuits. The voltage available is 12 VDC with a maximum load current of 20 milliamps. This feature eliminates the need to mount an external DC power source for transducers or sensors used in your application.



CAUTION

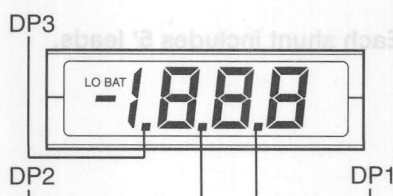
Do not exceed an excitation load current of 20 mA!

EX NEG
EX POS

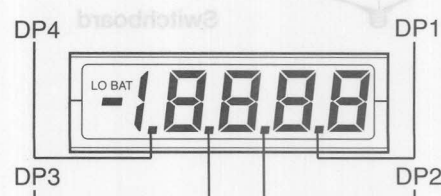
Backlight Option

Negative image, bright red, LED backlighting is available in the Mini-Max M235 and M245. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini Max, so no additional external power supply is required.

Decimal Point 3-1/2

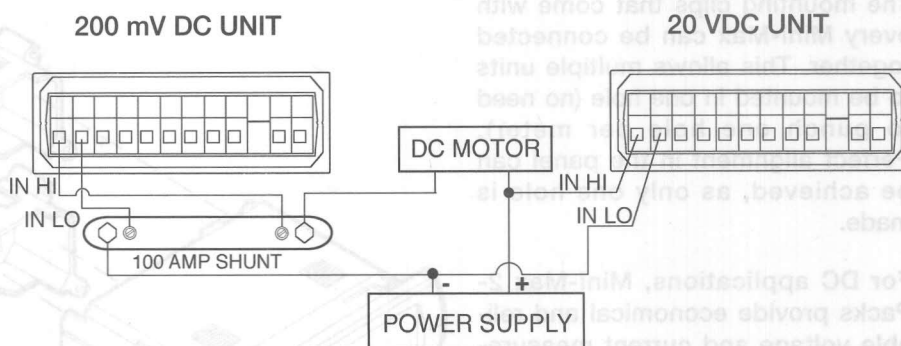


Decimal Point 4-1/2



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Current: A second Mini-Max DC Volt meter, configured for the 200 millivolt range, is used with a 100A/50mV shunt (sold separately) to measure the load current. The meter is first scaled to read 100.0 at 50 mV, by applying a 50 mV input to the meter and adjusting R9 and R10 until the display reads 100.0. The meter is connected to the shunt, and the shunt installed in series



on the negative leg of the power supply. The positive leg lead of the shunt is connected to the IN HI terminal, and the negative lead connected to the IN LO terminal. Consult the factory for the

The Mini-Max units will indicate the power supply voltage and load current of the motor.

Your Mini-Max Voltage Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range	Excitation Output
M235 M245	3-1/2 Digit Indicator 4-1/2 Digit Indicator	0 120 VAC 1 220 VAC 2 12 VDC 3 24 VDC 4 48 VDC	11 200 mV 12 2 V 13 20 V 14 200 V 15 750 V	0 None 1 12 VDC
	0 Non Backlight 1 Negative Image Red			

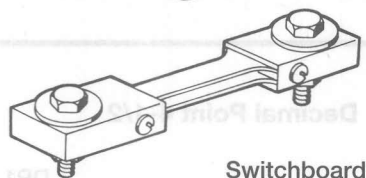
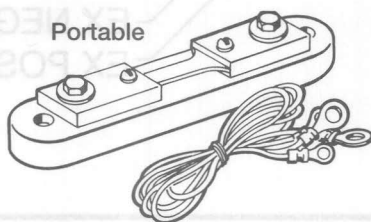
WARNING

The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Portable



External shunts enable digital panel meters to indicate higher currents than can be provided with self-contained internal shunt meters. The shunt is installed in series with the load and source. The shunts produce a DCmV drop which is sent to the display unit. The Mini-Max can be scaled to display the actual current between the load and the source. Simpson manufactures Portable and Switchboard shunts.

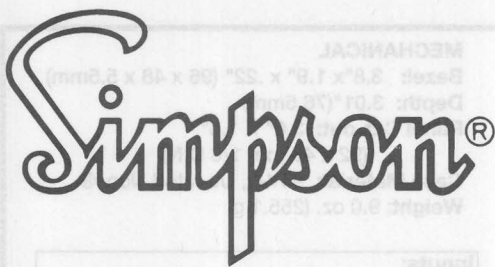
Each shunt includes 5' leads.

Portable Shunts 50 mV

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts 50 mV

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



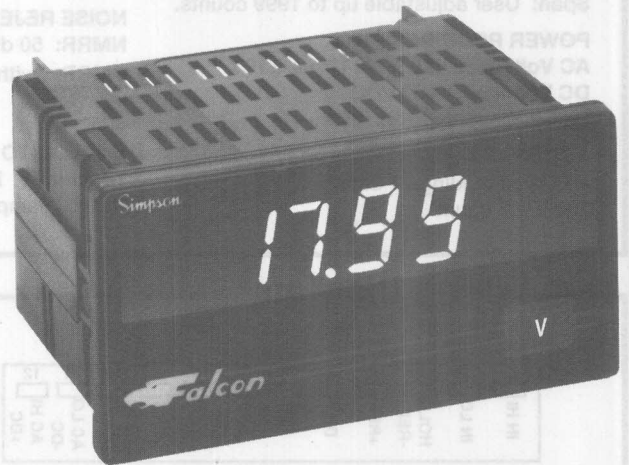
DC Voltage Indicators

Falcon F35 Series 3-1/2 Digit

- Full 3-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200mV, 2V, 20V, 200V, 750V
- Jumper Selectable Decimal Point
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply
- Optional Excitation Output of 12 VDC or 24 VDC

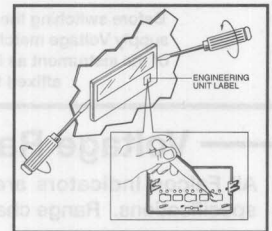
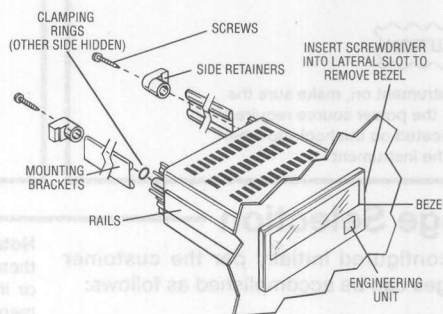
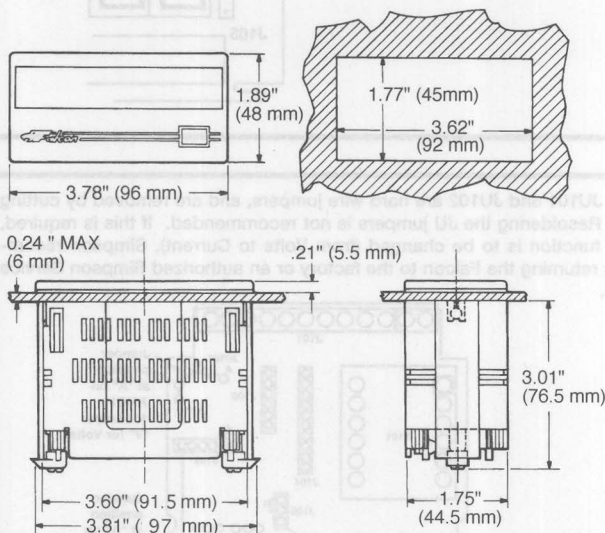
The Falcon Series digital indicators are premium quality 1/8 DIN meters for industrial applications with display scaling capability. All Falcon units feature jumper selectable decimal point (internal and on the connector for remote decimal point), providing wide application flexibility. In addition, signal input ranges are easy to change with jumpers on the main board. The Falcon has a 0.56" bright red LED display for high

visibility and an optional NEMA 4 cover to protect the display in washdown environments. Compactly designed for applications requiring minimal rear panel depth, the Falcon fits a standard 1/8 DIN panel cutout (92mm x 45mm) and requires only 3.01" behind the panel. A screw terminal connector is a standard feature for easy wiring of the power supply and signal input connections.



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Installation and Panel Cutout



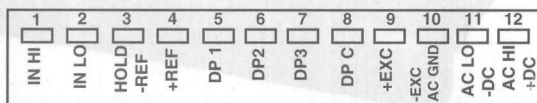
Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove the screws and side retainers from the rails as shown above. Position the Falcon into the cutout. From the rear of the panel, slide the panel mounting brackets back on to the rails until the brackets are flush against the back of the panel. Replace the side retainers and screws.

Engineering Label Placement

If replacement of the engineering unit label is required, insert a small screwdriver into the lateral slot on side of bezel and gently turn the screwdriver until the bezel snaps away from the case. Use tweezers to remove and replace the engineering unit label. Gently snap the bezel back in place.

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. IN HI is terminal #1, IN LO is terminal #2.

Supply Power: Connect the supply power to terminals #11 and #12. Note that if AC power is supplied, terminal #11 is for Neutral, and terminal #12 is for Hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch can be used to make the connection. To activate the display hold, short terminal blocks #3 and #4 (Hold Ref and +Ref).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions.

They are not to be used unmounted or for exploratory measurements in unknown circuits.

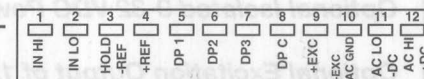
CAUTION

Before switching the instrument on, make sure the supply Voltage matches the power source required of the instrument as indicated on the hook-up label affixed to the instrument

Decimal Point Selection

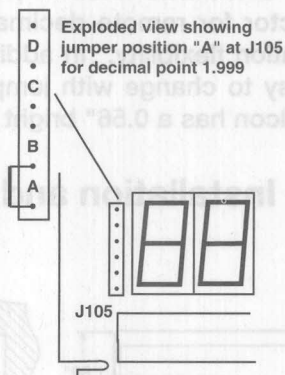
From terminal block: The decimal point can be set from the rear screw terminal block by connecting the appropriate decimal point (DP 1, 2, 3,) to the DP C terminal. The J105 jumper must be in the D position (see diagram under "From front panel").

Decimal Point	Connect
1.999	DP C to DP1
19.99	DP C to DP2
199.9	DP C to DP3
1999	No Decimal



From front panel: The decimal point can also be selected by removing the front bezel from the meter. Move the push-on jumper J105 across the correct letter.

Decimal Point	Jumper Position at J105
1.999	A
19.99	B
199.9	C
1999	D*
* No Decimal Point	



Voltage Range Selection

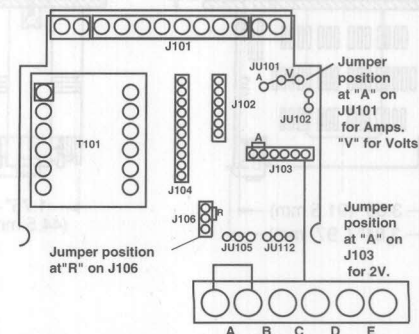
All Falcon Indicators are configured initially per the customer specifications. Range changes can be accomplished as follows:

Remove the brackets and side retainers from the unit. Next, remove the O-rings from the two rear posts where the brackets are screwed in. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

If a new range is selected, the calibration procedure must also be performed. See the chart below for jumper locations.

Input Range	J103	J106	JU101	JU102
200 mV	C	R	V	YES
2 V	A	R	V	NO
20 V	B	R	V	NO
200 V	D	R	V	NO
750 V	E	R	V	NO

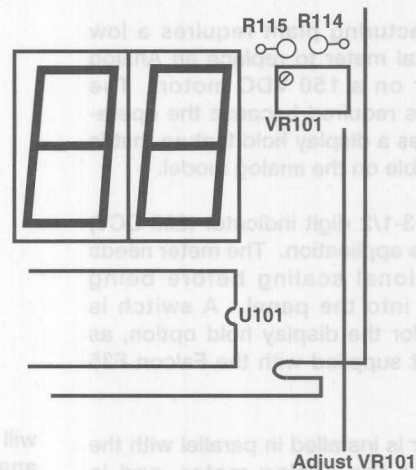
Note: JU101 and JU102 are hard wire jumpers, and are removed by cutting them. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed (from Volts to Current), Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center.



Display Scaling

The Falcon can be easily scaled to display any engineering unit. For example, if a 20 V signal is being monitored, and you want the meter to display 0-150%:

- 1) Remove the front bezel with a small screwdriver.
- 2) Apply the maximum signal input for the meter (19.99 V signal).
- 3) Adjust the potentiometer VR101 located on the right side of the display board to display the maximum reading desired (150.0%). Maximum value is adjustable from 1200 - 1999; for other ranges, please consult the factory.
- 4) Replace the bezel carefully.

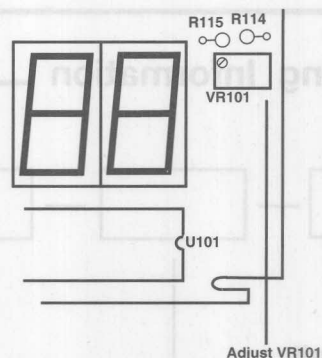


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Calibration

The Falcon is calibrated at the factory per order. If you change the range, and have moved the jumpers, your Falcon will need to be recalibrated.

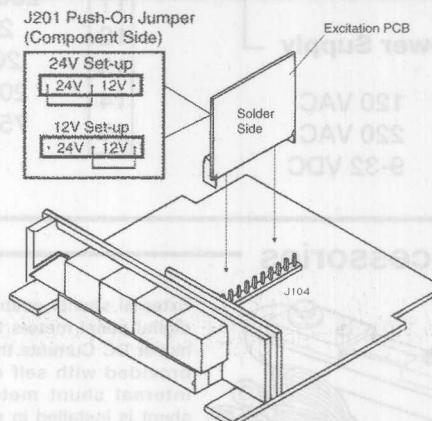
- 1) Remove the bezel with a small screwdriver.
- 2) Apply an input signal to the connector.
- 3) Adjust the potentiometer (VR101) located on the right side of the display board until the display indicates the value of the input signal or desired display value. For example, if a 19.99 V signal is applied, adjust the potentiometer until the display indicates 19.99 (V).
- 4) Replace the bezel carefully, and install the meter.



Excitation Output

An optional feature of the Falcon is the 12VDC or 24 VDC Excitation output. The Falcon is set at the factory per your order to include an Excitation plug-in printed circuit board in the range you specify. Excitation supply allows you to power external transformers and transducers without having to set up additional DC power sources for them.

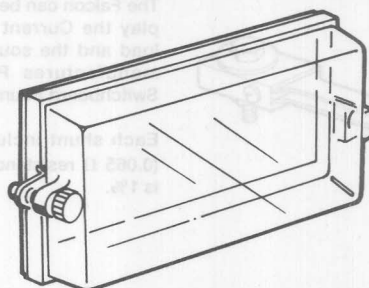
If your application changes, you can easily change the Excitation value. The Excitation supply can be reconfigured by moving push-on jumper J201 (located on the Excitation board). To change the Excitation output value, move the jumper to the correct position shown in the diagram.



Nema 4 Cover

An optional NEMA 4 cover is available for use with all Falcon series indicators. This cover will help protect the meter in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



Application Example

A manufacturing plant requires a low cost Digital meter to replace an Analog Indicator on a 150 VDC motor. The upgrade is required because the operator requires a display hold feature that is not available on the analog model.

A Falcon 3-1/2 digit indicator (200 DCV) can fit this application. The meter needs no additional scaling before being installed into the panel. A switch is required for the display hold option, as one is not supplied with the Falcon F35 meter.

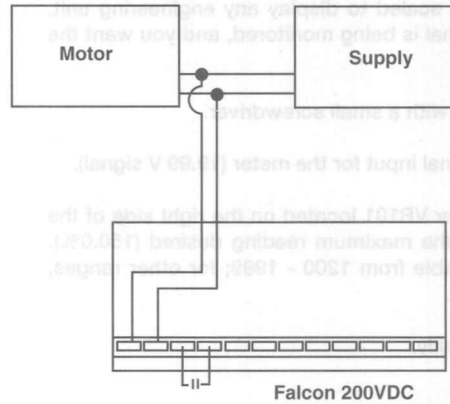
The meter is installed in parallel with the motor like the analog meter, and is ready to be placed in the panel.

The Falcon is only 3.01" deep, fitting well into the restricted panel space. It

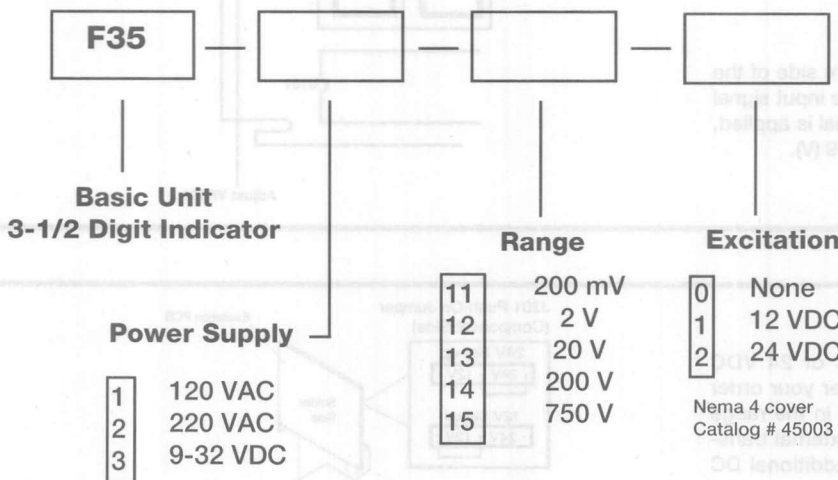
will take up about as much space as the analog meter it replaced. In addition, display hold is a standard feature on the Falcon. By shorting connections #3 and #4, the operator can hold the display to take a reading, and then remove the

short to reactivate the indication mode. A switch can be used to short the connections.

The meter is shipped ready to install, keeping down-time to a minimum.



Ordering Information



Safety Symbols

WARNING

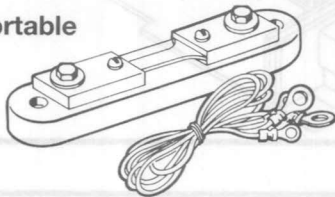
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

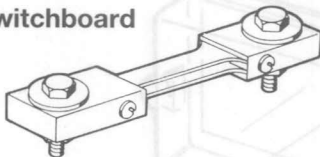
Accessories

Portable



External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Falcon can be scaled to display the Current between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

Switchboard



Each shunt includes 5' leads (0.065 Ω resistance). Accuracy is 1%.

Portable Shunts (50 mV)*					Switchboard (50 mV)**		
Amp	Voltage Drop	Jumper Across R114	Range of Readout	Catalog Number	Amp	Voltage Drop	Catalog Number
1	50	Yes	1.00	06700	100	50	06500
5	50	Yes	5.00	06706	150	50	06503
10	50	Yes	10.0	06704	200	50	06504
15	50	Yes	15.0	06705	250	50	06505
20	50	Yes	20.0	N/A	300	50	06506
25	50	Yes	25.0	06707	400	50	06507
30	50	None	30.0	06708	500	50	06508
50	50	None	50.0	06709			
75	50	None	75.0	06711			
100	50	Yes	100	06713			
150	50	Yes	150	06714			
200	50	Yes	200	06715			
10	100	Yes	10.0	06716			
30	100	Yes	30.0	N/A			
100	100	None	100.0	06717			
200	100	Yes	200	N/A			
10	200	Yes	10.00	N/A			
20	200	Yes	20.0	N/A			
100	200	Yes	100.0	N/A			
200	200	None	199.9	N/A			

* Portable and Switchboard shunts should be used with 200 mV meters.

** All Switchboard shunts require a jumper across R114.



DC Voltage Indicators

Falcon F45 Series 4-1/2 Digit

- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units
- Precision Microprocessor Design
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 5 User Selectable Ranges: 200mV, 2V, 20V, 200V, 750V
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply

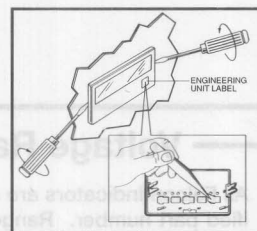
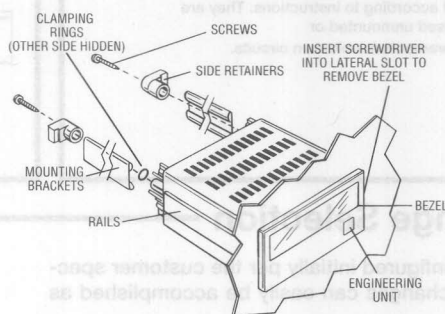
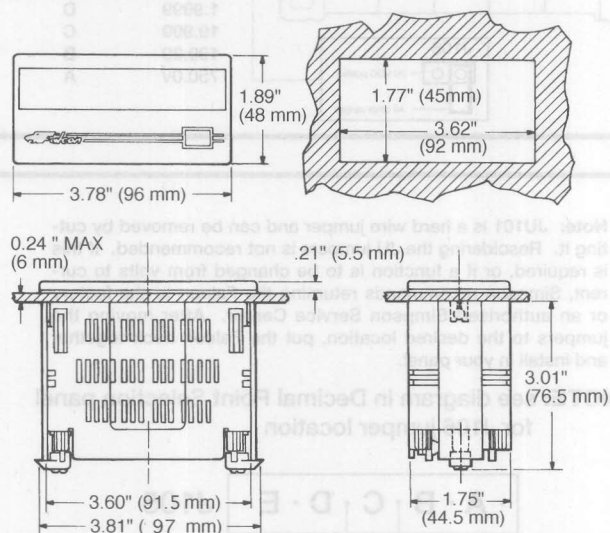


B
1
1
9

The Falcon Series digital indicators are premium quality 1/8 DIN meters for rough industrial applications with multi-function and range capability. All DC Voltage units feature display scaling and selectable decimal point providing the ultimate in application flexibility. The meter is designed to operate from either 120 VAC, 220 VAC (50 to 400 Hz), or 9 to 32

VDC. For high visibility, the Falcon has a 4-1/2 digit 0.56" bright red LED display and uses precision circuitry to provide a basic accuracy of 0.02% ± 1 digit. A screw type terminal block is provided standard for easy installation and a NEMA 4 splash-proof lens cover is available for wash down areas.

Installation and Panel Cutout



Mounting Instructions

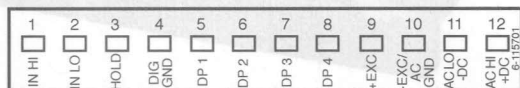
The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. These are terminals #1 and #2.

Supply Power: Connect the power to terminals #11 and #12. Note that if AC power is applied, terminal #11 is for neutral, and terminal #12 is for hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch or computer, etc. can be used to activate this feature. To install this feature, short circuit terminal block J112, Pins 3 and 4 (Hold and DIG GND).

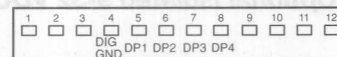
WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

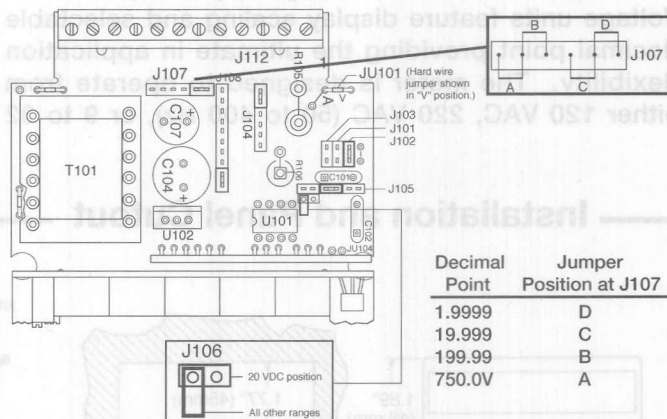
Decimal Point Selection

From terminal block J112: The decimal point can be set from the rear screw terminal block J112. Connect the appropriate DP point (DP 1, 2, 3, 4) to the DIG GND terminal. Internal jumper (J107) should be removed and stored on the last contact of J107.

Decimal Point	Connect
1.9999	DIG GND to DP1
19.999	DIG GND to DP2
199.99	DIG GND to DP3
750.0	DIG GND to DP4



From main board: The decimal point can also be selected by removing the top half of meter case. Move the push-on jumper J107 across the correct letter.



Decimal Point	Jumper Position at J107
1.9999	D
19.999	C
199.99	B
750.0V	A

Voltage Range Selection

All Falcon Indicators are configured initially per the customer specified part number. Range changes can easily be accomplished as follows:

Remove the brackets and sliding rails from the unit. Next, remove the O-rings on the rear bracket mounts. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

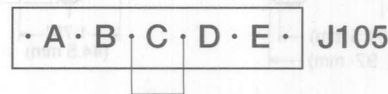
Note: If a new range is selected, the calibration procedure must also be performed. Only perform this section if a different function or range is required.

Input Range	J105 PJ	J106 PJ	J101 PJ	J102 PJ	J103 PJ	JU101* Jumper Position
200 mV	C	NO	NO	YES	NO	V
2V	A	NO	YES	NO	NO	V
20V	B	YES	YES	NO	NO	V
200V	D	NO	YES	NO	NO	V

* 750 Volt range may be configured upon order by factory or authorized Simpson Modification Center

Note: JU101 is a hard wire jumper and can be removed by cutting it. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed from volts to current, Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center. After moving the jumpers to the desired location, put the Falcon back together and install in your panel.

NOTE: see diagram in Decimal Point Selection panel for J106 jumper location



Example: 200 mV input

Display Scaling

The Falcon display can be easily scaled to display any engineering unit. Remove the front bezel with a small screwdriver. The scaling procedure is performed at terminal J1 located on the left side of the display board. There are four sets of pins on J1 as shown in the drawing. Each group of pins programs a particular parameter of the scaling procedure when a push-on jumper (supplied with Falcon) is momentarily placed across a set of pins.

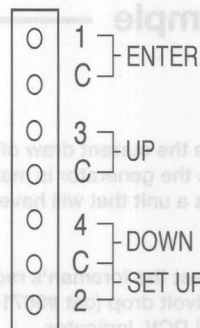
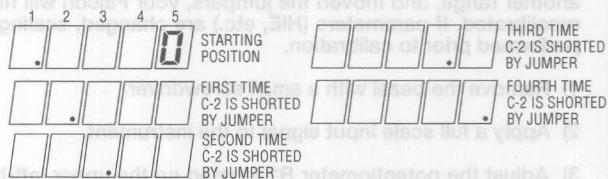
Before scaling the parameters, begin by disconnecting power to the Falcon. Place push-on jumper onto "SETUP" pins C and 2. Then apply power. At this point the Falcon performs a self test (scrolls LED display showing numerals 1 through 5) and then indicates LoE allowing you to enter the low electrical input value.

The scaling parameters for electrical low input value(LoE), electrical high input value(HiE), display low value(Lo), and display high value (Hi) are performed in the same manner as follows:

Remove push-on jumper from C-2 and then replace. Numeral zero or digit of LoE value (set at the factory) and flashing decimal point are displayed at starting LED position. The digit to be entered is always to the left of the flashing decimal point. The flashing decimal point is moved one position each time the push-on jumper is momentarily placed across "SETUP" pins C and 2. Change the value at the LED position chosen by momentarily placing jumper across "UP" pins C and 3. This will increase the value by 1 for each repetition. Repeat jumper placement until desired value is displayed. To decrease a display value, momentarily place jumper across "down" pins C and 4.

After the desired numeric value is obtained it is necessary to remove the jumper and momentarily place it across the "ENTER" pins C and 1 to store value in memory. LED display indicates next parameter. Repeat this procedure through each parameter.

After programming the last parameter (Hi) of the scaling procedure, LED will display "END" and then indicate scaled value of electrical input to the meter. The unit is now in "run" mode.



Enter-Saves digits displayed and advances to next scaling parameter when jumper makes momentary contact with pins 1 and C.

UP-Changes digit displayed to next ascending value when jumper makes momentary contact with pins 3 and C.

DOWN-Changes digit displayed to next descending value when jumper makes momentary contact with pins 4 and C.

SETUP-Starts scaling cycle of the four scaling parameters (LoE, HiE, Lo and Hi) and selects digit to be entered to the left of the flashing decimal point on display when jumper makes momentary contact with pins 2 and C.

Typical Scaling Application

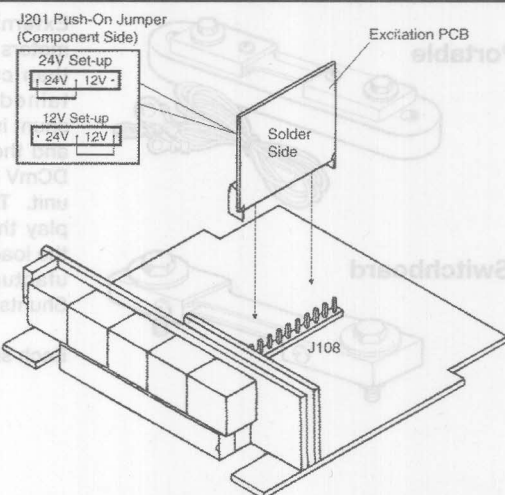
50mV Shunt; NOTE: 200mV range is used

Electrical Characteristics Falcon LED Display

Current: 100 Amps	LoE: 0	Lo: 0
Voltage Drop: 50mV	HiE: 50.00	Hi: 100.00

Excitation Output

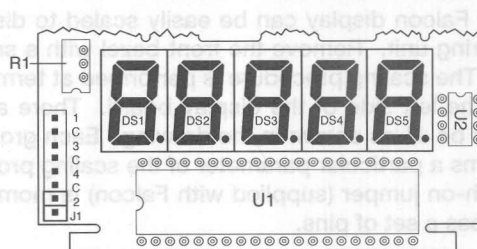
An optional feature of the Falcon is a 12 or 24 VDC output. The Falcon is set at the factory per your order to include an excitation plug-in printed circuit board. This PCB, located on the main board can be reconfigured by moving push-on jumper J201 to change the excitation output as shown in the diagram.



Calibration

The unit is calibrated at the factory per order. If you selected another range, and moved the jumpers, your Falcon will need to be recalibrated. If parameters (HiE, etc.) are changed, scaling must be performed prior to calibration.

- 1) Remove the bezel with a small screwdriver.
- 2) Apply a full scale input signal to the instrument.
- 3) Adjust the potentiometer R1 located on the upper left-hand side of the display board until display shows the full scale voltage.
- 4) Replace bezel carefully

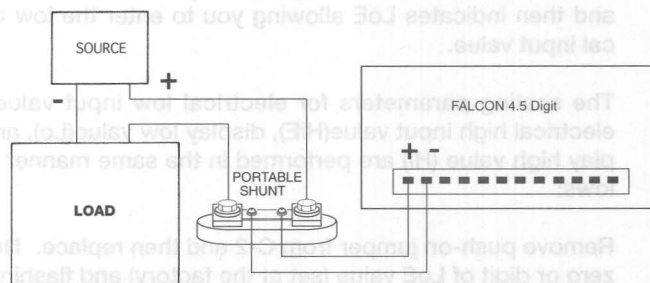


Application Example

A manufacturer needs to measure the current draw of a load. If the current rises above 100 Amps the generator is malfunctioning. The foreman in charge wants a unit that will have good resolution.

The Falcon 4-1/2 digit unit can meet the foreman's requirements. A 100 Amp shunt having a 50 millivolt drop (cat #06713) is used in conjunction with a Falcon 4-1/2 DCV indicator.

The shunt is connected in series with the source and load, and the lead wires are connected to the Falcon DC Volt indicator (200mV unit).



To scale the display, LoE should be set at 0 (mV) and HiE set at 50.00 (mV). Lo should be set at 0 (Amps) and Hi set at 100.00 (Amps).

Ordering Information

F45							
Basic Unit		Range		Excitation			
4-1/2 Digit Indicator							
Power Supply							
1	120 VAC	11	200 mV	0	None		
2	220 VAC	12	2 V	1	12 VDC		
3	9-32 VDC	13	20 V	2	24 VDC		
		14	200 V				
		15	750 V				

Nema 4 cover
Catalog # 45003

Safety Symbols

WARNING

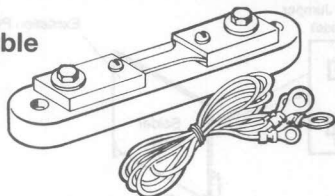
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

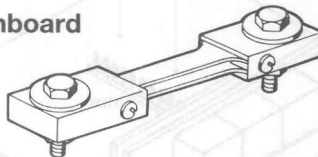
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Portable



Switchboard



External shunts enable digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Falcon can be scaled to display the actual Current load between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

Each shunt includes 5' leads.

Portable Shunts
(50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts
(50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Voltage Indicators

2842 & 2843 Series 4-1/2 Digit

■ 4 Voltage Ranges Available: 200 mV, 2 V, 20 V, 200 V

■ Jumper Selectable Decimal Point

■ Input/Output Edge Connector

■ 4-1/2 digit, 0.56" Red LED Display

■ Model 2842 Requires 117 VAC Power Supply

■ Model 2843 Requires 5 VDC Power Supply

■ Optional 234 VAC Power Supply

■ Optional Display Hold

■ Additional Rear Terminal Connector Available

■ Optional Cutout Adapters

■ Optional "U" Shaped Mounting bracket

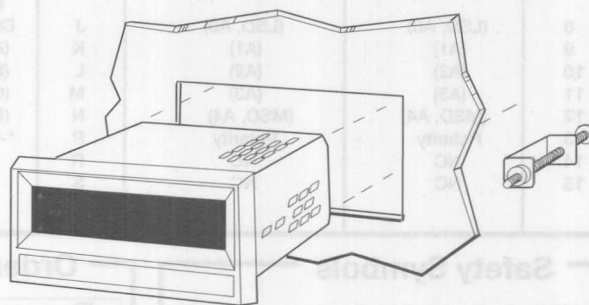
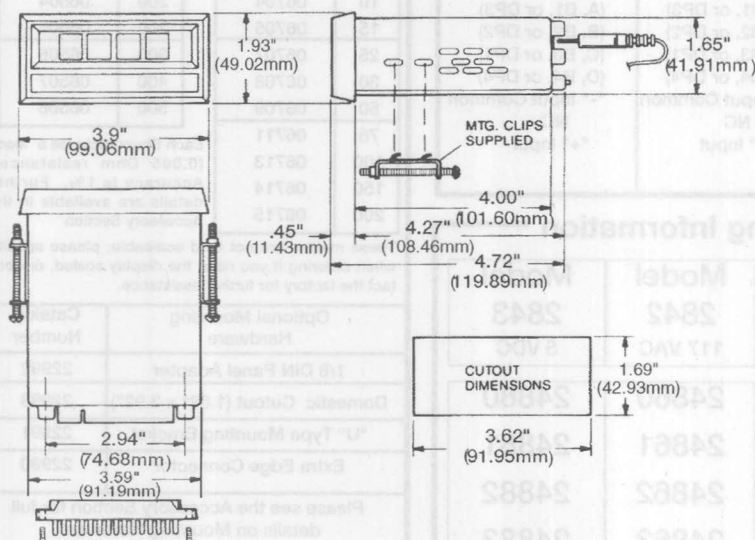


B
1
2
3

Simpson's 2842 and 2843 Series meters offer high accuracy with up to 10 μ V resolution. Model 2842 requires a 117 VAC input at 50-400 Hz, and model 2843 requires a 5 VDC input at 500 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 4-1/2 digit display is easily readable from a distance (about 25 feet). Panel adapters are avail-

able for 1/8 DIN panel cutouts, and for old Nema size cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. The optional Display Hold can be activated from the rear connector (when ordered). Typically a switch (not supplied) is used to activate the Display Hold so the operator may take a reading from the display.

Installation and Panel Cutout



Mounting Instructions

The 2842 and 2843 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications
connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Display Hold

This optional feature must be specified when ordering. By shorting Pin H to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and

220 VAC power supplied, return the unit to our factory or to an Authorized Service Center. If the unit is powered by VDC, attach the VDC return to Pin #1 and A. The "+" VDC is connected to Pin #4.

BCD Outputs

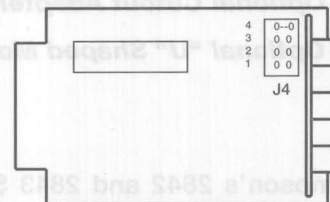
The unit is shipped configured with BCD outputs. If Remote Decimal Point is chosen, the BCD output must be disconnected. The unit uses the same connector points for both features.

Remote Decimal Point

This optional feature allows you to change the decimal point without having to disassemble the meter. Please note that if you want this option, the BCD outputs and Display Hold are not available, as these options use the same terminal pins.

Pin Number	2842 Circuit	2843 Circuit	Pin Number	2842 Circuit	2843 Circuit
1	3rd wire GND	5VDC Return	A	3rd wire GND	5 VDC Return
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	(Strobe)	(Strobe)	H	(Hold/Remote DP Common)	(Hold/Remote DP Common)
8	(LSD, A0)	(LSD, A0)	J	Digital Common	Digital Common
9	(A1)	(A1)	K	(A, B1, or DP3)	(A, B1, or DP3)
10	(A2)	(A2)	L	(B, B2, or DP2)	(B, B2, or DP2)
11	(A3)	(A3)	M	(C, B3, or DP1)	(C, B3, or DP1)
12	(MSD, A4)	(MSD, A4)	N	(D, B4, or DP4)	(D, B4, or DP4)
13	Polarity	Polarity	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Jumper Position	Decimal Point Position
4	1000.0
1	100.00
2	10.000
3	1.0000



The Jumper Positions are printed on the main circuit board of the meter. After moving the jumper to the location you selected, slide the circuit board back into the meter case and re-assemble the meter.

Accessories

Portable Shunts (50 mV) Switchboard Shunts (50 mV)

Amps	Cat. Number	Amps	Cat. Number
1	06700	100	06500
5	06703	150	06503
10	06704	200	06504
15	06705	250	06505
25	06707	300	06506
30	06708	400	06507
50	06709	500	06508
75	06711		
100	06713		
150	06714		
200	06715		

Each Shunt includes 5' leads (0.065 Ohm resistance). Accuracy is 1%. Further details are available in the Accessory Section

These meters are not field scaleable; please specify when ordering if you need the display scaled, or contact the factory for further assistance.

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Extra Edge Connector	22990

Please see the Accessory Section for full details on Mounting Hardware.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

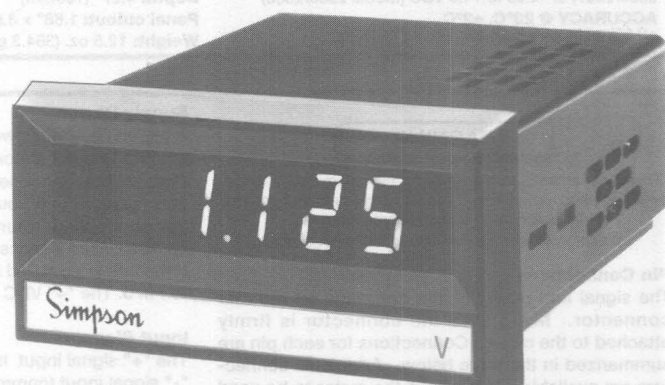
Range	Model 2842	Model 2843
	117 VAC	5 VDC
200 mV	24860	24880
2 V	24861	24881
20 V	24862	24882
200 V	24863	24883



DC Voltage Indicators

2865, 2866, 2867, & 2868 Series 3-1/2 Digit

- 4 Voltage Ranges: 200 mV, 2 V, 20 V, 200 V
- Input/Output Edge Connector
- 3-1/2 digit, 0.56" Red LED Display (2865/2866) or Orange LED Display (2867/2868)
- Jumper Selectable Decimal Point
- Models 2865/2867 Require 120 VAC Power Supply
- Models 2866/2868 Require 5 VDC Power Supply
- Optional 234 VAC Power Supply
- Additional Rear Terminal Connector Available
- Optional Cutout Adapters
- Optional "U" Shaped Mounting Bracket

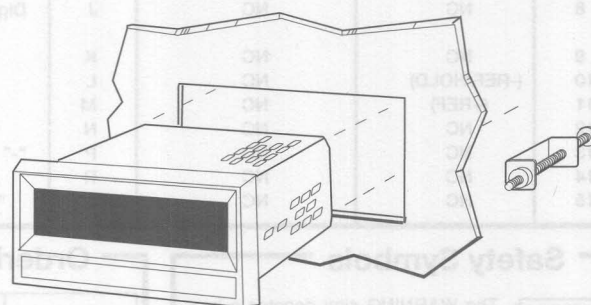
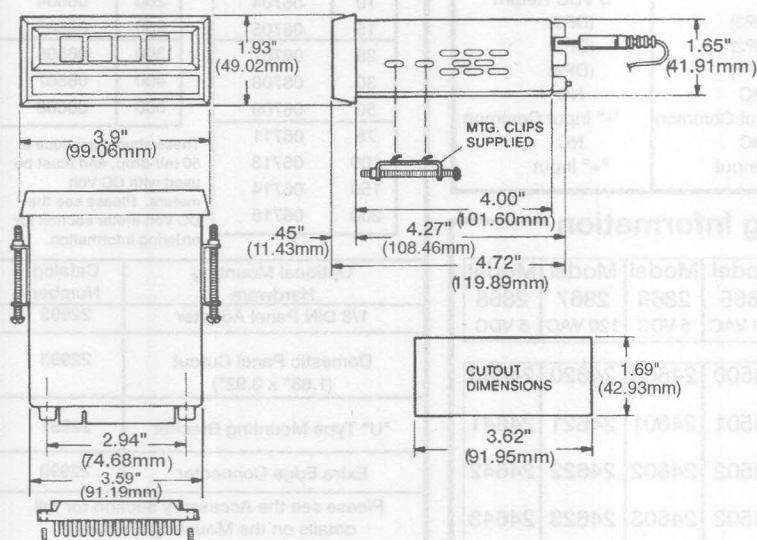


B
1
2
5

Simpson's 2865, 2866, 2867 and 2868 Series meters offer high accuracy with high reliability. Models 2865 and 2866 have a red LED display. Models 2867 and 2868 have an orange LED display. Models 2865 and 2867 require a 120 VAC input at 50-400 Hz, and models 2866 and 2868 require a 5 VDC input at 200 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 3-1/2 digit display (0.56" high) is

easily readable from a distance (about 25 feet). Panel cutout adapters are available for 1/8 DIN panel cutouts, and for older "Nema" sized cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied).

Installation and Panel Cutout



Mounting Instructions

The 2865, 2866, 2867, and 2868 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 7 segment, red LED - 2865/66;
orange LED 2867/68

Height: 0.56" (14.2mm)

Decimal point: 2865/66 Fixed with range
2867/68 Jumper Selectable

Overrange indication: All digits blank except "1"
above 1999 counts

POWER REQUIREMENTS

AC Voltages: 120 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA
220 V, $\pm 10\%$, 50 Hz to 400 Hz, 3VA

DC Voltages: 5 V, $\pm 5\%$ at 200 mA

Rated Circuit to Ground Voltage: 250 VDC (Model
2865/2867) or -4.06 to +4.5 VDC (Model 2866/2868)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$
 $\pm 0.1\%$ of input + 5 counts (45 Hz to 1KHz)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -40 to 60 °C

Relative Humidity: 0 to 85%, non-condensing

Temp. Coefficient: $\pm 0.01\%$ of input + 0.05 count / °C

Warmup time: Less than 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope

Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)

Depth: 4.27" (109mm)

Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: DC Voltage

Range	Display Resolution	Input Resistance
200 mV	100 μV	100 M Ω
2 V	1 mV	100 M Ω
20 V	10 mV	10 M Ω
200 V	100 mV	10 M Ω

Overload protection on all ranges
equals 250 V.

B

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Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

By shorting Pin 10 to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This optional feature is available from the factory or from one of our Authorized Service Centers, and must be specified when ordering. This option is not available on 2866 or 2868.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin J. The "+" VDC is connected to Pin #4.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

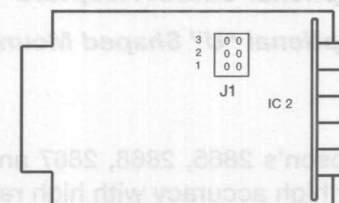
Remote Decimal Point

Remote Decimal Point selection is available from our factory or an Authorized Service Center as an option, allowing you to move the decimal point through terminal connections on the edge connector. This feature can be ordered with the unit, or it can be equipped after purchase through one of our Authorized Service Centers.

Jumper Decimal Point

The Decimal Point can be changed by moving Jumper J1 inside the unit. The meter must be disassembled. Remove the Edge Connector first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board. This option is not available on 2866 or 2868.

Jumper Position	Decimal Point Position
1	100.0
2	10.00
3	1.000



Accessories

External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunts provide a DCmV drop which is sent to the display unit.

Each shunt includes 5' leads (0.065 Ohm resistance) with an accuracy is 1%.

Portable Shunts

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

These shunts produce a 50 mV drop, and must be used with DC Volt meters. Please see the DC Volt meter section for ordering information.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

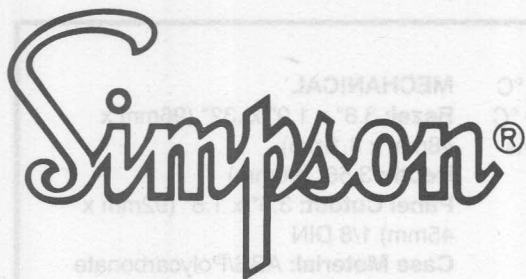
CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model 2865 120 VAC	Model 2866 5 VDC	Model 2867 120 VAC	Model 2868 5 VDC
200 mV	24500	24600	24620	24640
2 V	24501	24601	24621	24641
20V	24502	24602	24622	24642
200 V	24503	24603	24623	24643

Optional Mounting Hardware	Catalog Number
1/8 DIN Panel Adapter	22992
Domestic Panel Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Extra Edge Connector	22990
Please see the Accessory section for full details on the Mounting Hardware	



DC Voltage Controllers

HAWK II

Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- Easily Programmed from the Front Panel
- User Friendly Software Functions Include:
 - Password
 - Display Scaling
 - Decimal Point Selection
 - Zero, One, or Two Setpoints
 - Peak-Valley Values
 - Time Delay & Hysteresis
- Screw Terminal Connector for Easy Installation
- 1/8 DIN, Shallow Depth case, 3.5" (89mm) for Restricted Space Behind Panel
- Nema 4 / IP 65 Front Panel
- 5 DC Voltage Ranges: 200 mV, 2 V, 20 V, 200 V, 690 V
- Optional 5 Amp Relay Outputs, Excitation Outputs, and Analog Outputs.



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2
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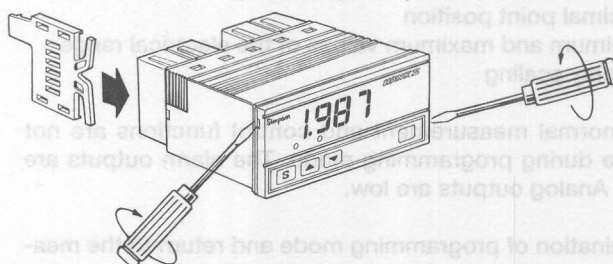
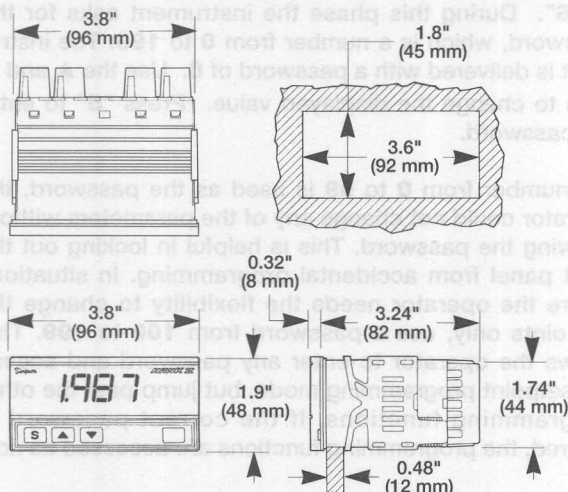
Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.

Depending on the password value chosen the customer may lock out all changes, or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout

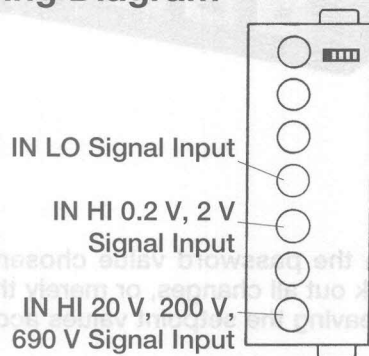


Insert the instrument into the panel and fasten it with the two brackets provided.

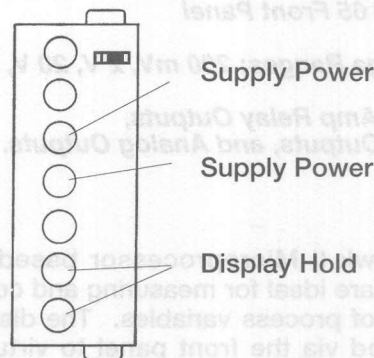
To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

ACCURACY:0.2% $\pm$ 2 digits**ENVIRONMENTAL****Technique:** Special Dual Slope**Rate:** Approximately 2 display updates per second, nominal

2 V	1 mV	100 K Ohm	230V
20 V	10 mV	1 M Ohm	690V
200 V	0.1 V	1 M Ohm	690V
690 V	1 V	1 M Ohm	690V
Max 1 min.			

Wiring Diagram

Input Signal: connect the signal to be monitored to the **IN HI** and the **IN LO** terminals. Note that the **IN HI** signal has two terminals that can be used, depending on the amount of Voltage being monitored. The upper **IN HI** terminal accepts 0.2 and 2 V. The lower **IN HI** terminal accepts 20, 200, and 690 V.



Supply Power: Connect the power to the supply power terminals.

Display Hold: Short the terminals marked **HOLD** to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End"

Access to programming

Press the "**S**" key and the $\blacktriangle$. The display should show "**PAS**". During this phase the instrument asks for the password, which is a number from **0** to **199**. The instrument is delivered with a password of **0**. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "**S**" to enter the password.

If a number from **0** to **99** is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from **100** to **199**. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the **"S"** key and the **▼** key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the **▲** key so the display reads **99**. Press the **"S"** key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

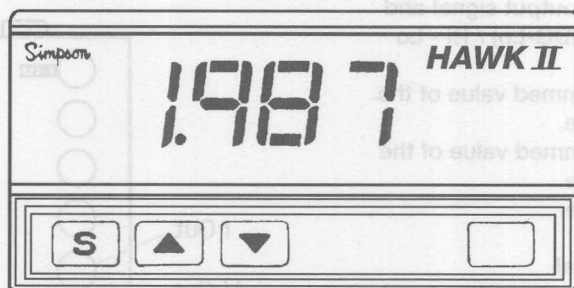
Programming a new password

To retain the present value for the password, press the **"S"** key to pass to the next parameter.

To modify the password, press the **▲** and **▼** keys to affect the value. Remember that the value must be a number from **0** to **199**. Press **"S"** to move to the next parameter.

Decimal Point Selection

The display will show **"dP"** for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the **▲** and **▼** keys. Press **"S"** to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the **"S"** key. Use the **▲** and **▼** keys to change the displayed value. Press the **"S"** key when the correct value is displayed.

The Display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the **▲** and **▼** keys to change the displayed value. Press the **"S"** key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (LOE to HiE)

Programmed display span: 0 to 100.0 (LO to Hi)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show **"Hi"** for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the **▲** and **▼** keys to change the displayed value. The maximum is **+1999**. Press the **"S"** key when the correct value is displayed.

The display will show **"LO"** signifying the minimum of the display span. The display shows the valued stored in memory. To modify the value, use the **▲** and **▼** keys. The value can be as low as **-1999** in the DC Voltage meter. Press the **"S"** key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the **Programming the Relays** section.

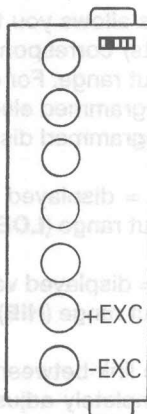
$$\left| \frac{\text{HiE} - \text{LOE}}{\text{Hi} - \text{LO}} \right| \pm 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

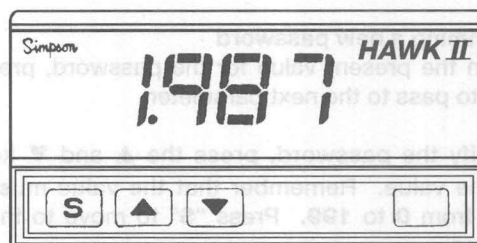
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo)+4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-1 VDC Output signal

Relationship between output signal and displayed value: $V = (RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-10 VDC Output signal

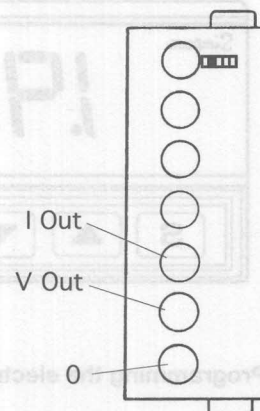
Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$

V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-1 V	Output 0-10 V
Overrange	EE	20 mA	1 V	10 V
Underrange	- EE	4 mA	0 V	0 V

NOTE:

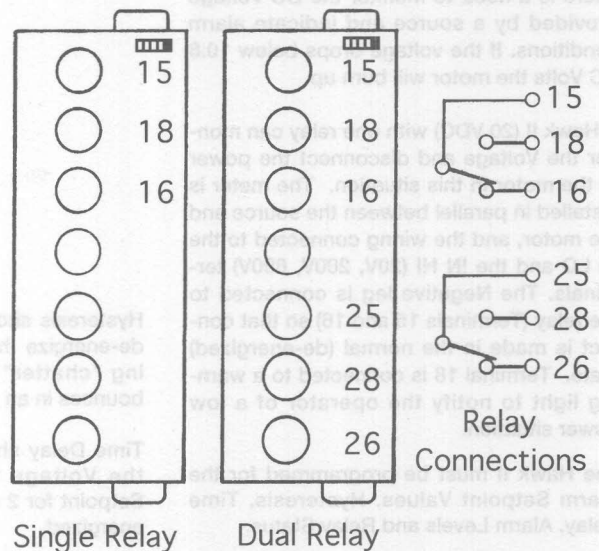
Analog output is not available in conjunction with Excitation

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ C	500 Ohm	N/A	Yes
0-1 V	±1% ±0.005V	±200 ppm/ C	N/A	≤ 3 Ohm	Yes
0-10 V	±1% ±0.05V	±200 ppm/ C	N/A	≤ 3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the set points.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **HI** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate "chatter" in the relays. The value is selected from 1 to 1999 counts.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the Setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the Setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm; Normally Energized, or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed, and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

The Hawk II must be programmed for the Alarm Setpoint Values, Hysteresis, Time Delay, Alarm Levels and Relay Status.

Time Delay should be set at 2, allowing the Voltage to fall below the Alarm Setpoint for 2 seconds before the relay is energized.

Relay Status is normally de-energized (nd), indicating the status of the relay in the absence of an alarm situation.

Ordering Information

Basic Unit		Output Signal		Excitation	
H235	3-1/2 Basic Unit	0	None	0	None
		1	4-20 mA	1	12 VDC
		2	0-1 V	2	24 VDC
		3	0-10 V		
Power Supply		Function/Range		Number of Relays	
1	120 VAC	0110	200 mV	0	None
2	220 VAC	0120	2 V	1	One
3	24 VAC	0130	20 V	2	Two
4	48 VAC	0140	200 V		
		0150	690 V		

Safety Symbols

WARNING

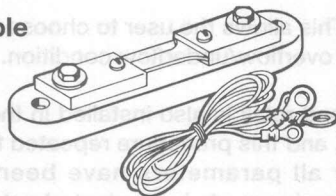
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

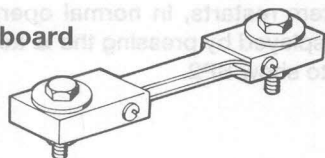
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Portable



Switchboard



External shunts enable digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Hawk II can be scaled to display the actual Current load between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

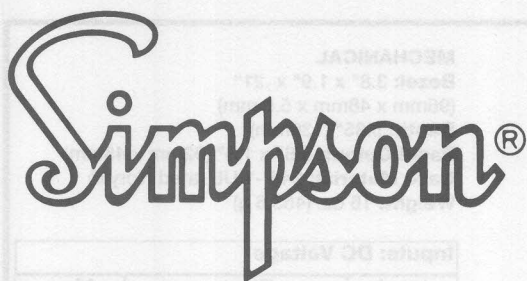
Each shunt includes 5' leads.

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Voltage Controllers

Hawk HK35 & HK45 series 3-1/2 & 4-1/2 Digit

- Easily Programmed From the Front Panel
- Software Functions Include:
 - Password
 - Display Scaling
 - One, or Two Setpoints
 - Decimal Point Selection
 - Time Delay & Hysteresis
- 2 Piece Screw Terminal Connector for Easy Installation
- 3-1/2 or 4-1/2 Digit, Bright Red Display 0.56" (14.2 mm) High
- 1/8 DIN Case Made of High Impact Noryl®
- 5 DC Voltage Ranges: 200 mV, 2 V, 20 V, 200 V, 750 V
- Display Hold
- Optional Nema 4 Front Panel Cover
- Optional 5 Amp Relays and Analog/Digital Outputs



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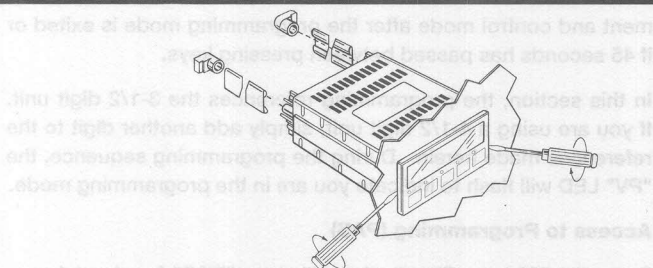
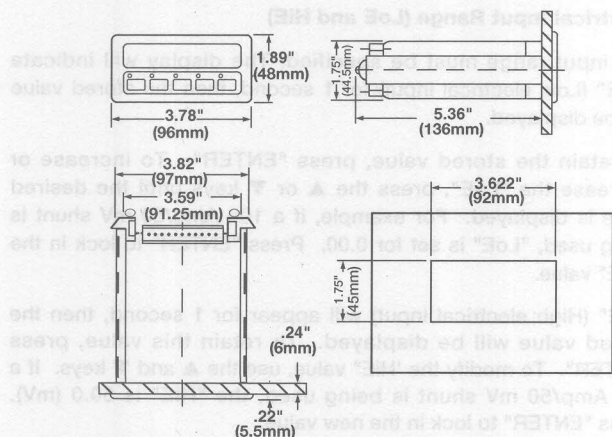
Simpson's Hawk Microprocessor based Controllers/Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Optional Peak Hold is available to replace the standard Display Hold, allowing the operator to observe peak values in the input signal.

Two optional 5 Amp Relays include front panel programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include

programmable decimal point and a password lockout feature. By using the password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl®. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the mounting brackets and side retainers provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 4 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 120, 240 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA

ACCURACY @ 25° C

HK35: 0.10% of input ± 1 digit (750 V: ± 2 digits)

HK45: 0.05% of input ± 1 digit (750 V: ± 2 digits)

Peak Hold HK35: 1.0% of input ± 40 digits
Peak Hold HK45: 0.5% of input ± 40 digits

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):
 ± 100 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 90 dB (1 K Ω unbalanced) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate:

HK 35: 4 times per second

HK 45: 2 times per second

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

Case Material: 94 V-1 UL rated Noryl®

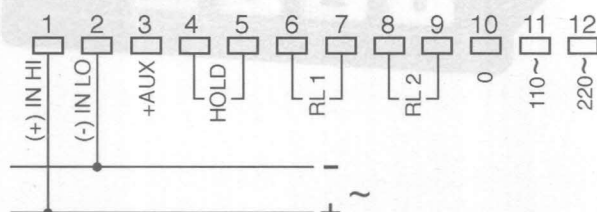
Weight: 16 oz. (453.6 g)

Inputs: DC Voltage

Input Range	Display Resolution		Max. Overload
	HK 35	HK 45	
200 mV	100 μ V	10 μ V	50 V
2 V	1 mV	100 μ V	100 V
20 V	10 mV	1 mV	100 V
200 V	100 mV	10 mV	250 V
750 V	1 V	100 mV	750 V

Input Impedance on all ranges = 1 M Ω

Wiring Diagram



Input Signal:

Connect the input signal to the IN HI and the IN LO terminals (#1 and #2).

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2"

LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" (Low electrical input) for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. For example, if a 100 Amp/50 mV shunt is being used, "LoE" is set for 0.00. Press "ENTER" to lock in the "LoE" value.

"HiE" (High electrical input) will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the $\blacktriangle$ and $\blacktriangledown$ keys. If a 100 Amp/50 mV shunt is being used, the "HiE" is 50.0 (mV). Press "ENTER" to lock in the new value.

Programming cont.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values from Portable or Switchboard shunts. For example:

Electrical Input Range: 0 to 50.0 (LoE to HiE)

Programmed Display Scaling: 0 to 100.0 (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "**Lo**" for 1 second. This is the minimum displayed value corresponding to the input range. Our example would be 0.0 (Amps). The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the **▲** and **▼** keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "**Hi**" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the **▲** and **▼** keys. By changing the high value, the input is scaled to display a new range. In our example, the Hi is 100.0, which programs the controller to display 100.0 (Amps) when a 50 mV signal is being monitored. Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the **▲** or **▼** key. The "SP1" LED will turn on, and the display will show set point #1. Press the **▲** key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "**SP**" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the **▲** or **▼** keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "**uP**" or "**do**" signifying high or low alarm level. Use the **▲** and **▼** keys to change the status. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the **▲** and **▼** keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "**dEL**" for 1 second, and then display the stored value. To change the value, use the **▲** and **▼** keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the **▲** or **▼** key. **▲** will make the status Normally Energized ("nE"), while the **▼** key will make the status Normally De-energized ("nd"). Press "ENTER" to store this setting in memory.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

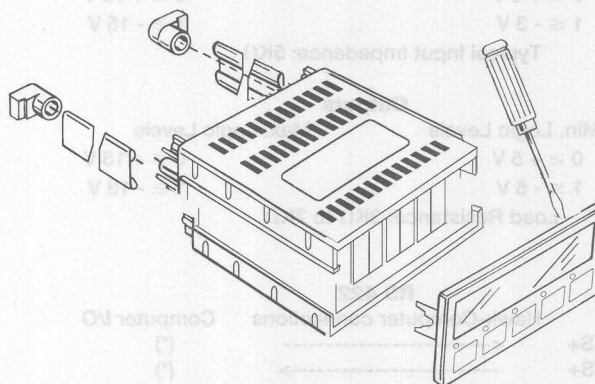
Exiting Programming Mode

After programming the relay(s), the Hawk automatically exits the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case. Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.



- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3\text{ V}$	$0 \leq +15\text{ V}$
$1 \leq -3\text{ V}$	$1 \geq -15\text{ V}$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5\text{ V}$	$0 \leq +13\text{ V}$
$1 \leq -5\text{ V}$	$1 \geq -13\text{ V}$

Load Resistance: 3K Ω to 7K Ω

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)
Pin 2A RTS+	----->	(*)

Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

Inputs

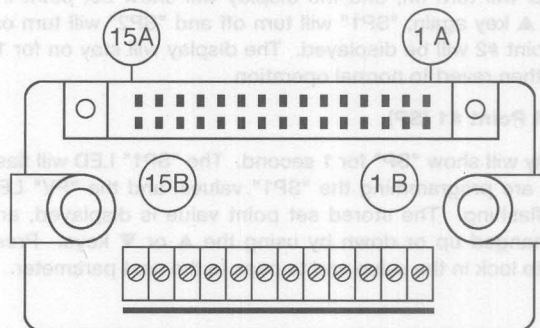
Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2\text{ V (diff)}$	$0 \leq +12\text{ V (diff)}$
$1 \leq -0.2\text{ V (diff)}$	$1 \geq -12\text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5\text{ V (diff)}$	$0 \leq +5\text{ V (diff)}$
$1 \leq -1.5\text{ V (diff)}$	$1 \geq -5\text{ V (diff)}$

Termination Resistances : 100 $\Omega \pm 10\%$

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.



CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company

853 Dundee Ave.

Elgin, IL 60120

(708) - 697 - 2260

Digital Outputs cont.

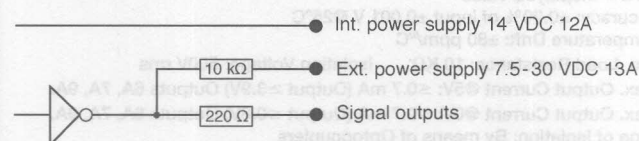
BCD Outputs

There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Function	Pin	Auxiliary Signals
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(lsd)	2nd digit	3rd digit	4th digit	5th digit(msd)
Value Pin	Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B	*10,000 5A
2 2B	20 2A	200 6B	*2,000 10B	
4 3B	40 3A	400 7B	*4,000 11B	
8 4B	80 4A	800 8B	*8,000 12B	

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Function	Pin	Auxiliary Signals
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin	Auxiliary Signals
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1
Underrange	9 A	Positive = logical status 0
Ground	10 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mADC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for DC Voltage controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mADC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mADC:

$$I = (16/Hi - Lo) \times (RDG - Lo) + 4$$

I = Output Current (mA)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. display value of the whole measuring range

Lo = Min. display value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C(HK 35)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

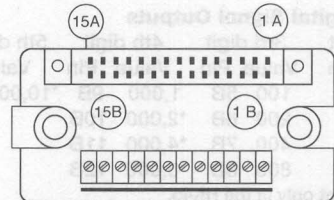
Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit Output Resistance $\leq 3\Omega$

The signal outputs are protected from short circuits.

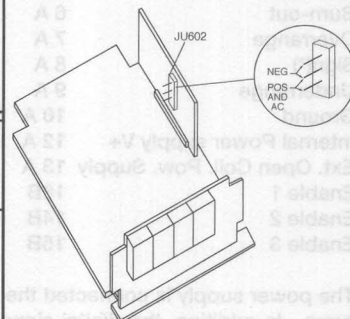
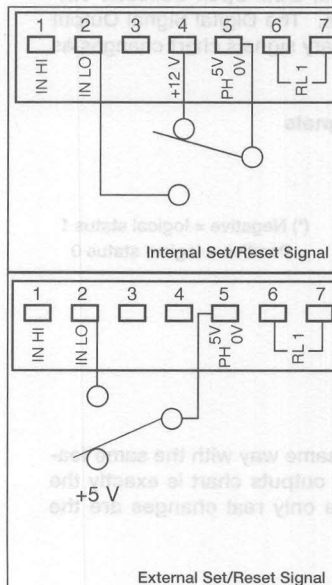


Peak Hold

The Peak Hold feature is used to display DC values, such as positive or negative Voltage peaks. This optional feature can be controlled internally or externally. The display will briefly "Hold" the peak value, and slowly "decay" to the current input signal. The decay rate is 1 digit per second for the 3-1/2 digit unit, and 5 digits per second for the 4-1/2 digit unit. Display Hold is not available for use when Peak Hold is ordered with the Hawk because the two features use the same terminal contacts.

To measure peak values, apply zero volts DC to the Peak Hold input (terminal #5) by simply connecting terminal #5 to terminal #2. To clear the reading using the internal source, apply a minimum of 5 VDC through a maximum of 12 VDC to terminal #5. This can be accomplished by connecting terminal #4 to #5. To clear the reading using an external reference, connect terminal #5 to an external reference. See the diagrams to the right for Internal vs. External set/reset modes.

The meter can be used to capture Negative Voltage or Negative Current Peaks. Units are assembled by the Factory or Mod Center for DC Positive Peak Values. Disassemble the unit and move the programmable jumper (JU602) to the next position as illustrated in the lower right diagram.



Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels correspond to the setpoint values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed,

without actually changing them.

The chart below shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,

4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

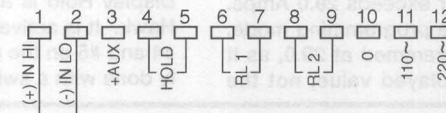
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals # 6 and #7, and relay #2 is wired from terminals #8 and #9.



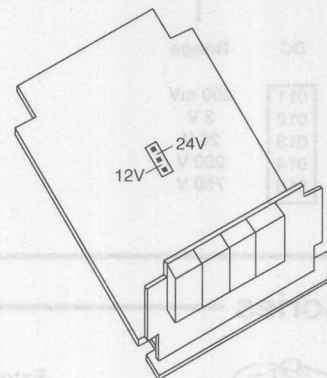
Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

Excitation Output

Excitation output is an optional feature for the Hawk Controller. 12 or 24 VDC excitation is available, preset to your specifications. The value can be changed in the field by moving the jumper on the main board (see diagram).

The Excitation output eliminates the need to set up expensive DC power supplies for external transmitters and transducers that can be used with the Hawk. The 12 Volt output supplies 30 mA maximum, and the 24 Volt output supplies 25 mA maximum.

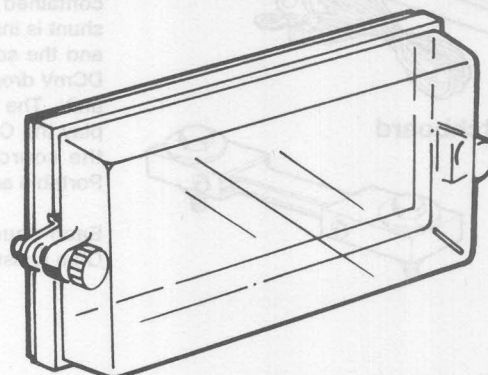
Please specify when ordering which value you need. The controller can be retrofitted with Excitation through the Factory or one of our Authorized Service Centers.



NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



display zero when a 50 mV drop exists across the shunt.

The Normally Closed Relay can be programmed to de-energize (close) when the signal input equals or exceeds 29.0 Amps. This is handled in the programming mode. The set point is programmed at 29.0, as it is based on the displayed value, not the

The Alarm Status is set at the factory for Normally Energized. This will turn off the relay, closing the contact, when the set point is reached or exceeded.

Display Hold is a standard feature on the Hawk. It is activated by shorting terminals #4 and #5 on the connector. This is usually done with a switch (not supplied). While

the display is held the alarm features remain active, and the relay will switch if the value exceeds 29.0 Amps (even if the held value is below the set point value of 29.0 Amps).

The Hawk is now programmed and ready to monitor the process.

Ordering Information

Power Supply		Peak Hold		Output Signal		Relays	
1	110/220 VAC	0	None	0	None	0	None
2	24/48 VAC	1	Yes	1	4-20 mA	1	One
3	9-32 VDC			2	0-1 V	2	Two
				3	1 mV/digit (HK-35)		
				4	0.1 mV/digit (HK-45)		
				5	RS 232C		
				6	RS 422		
				7	BCD Open Col.		
				8	BCD TRI-STATE		
				9	BCD O.C. W/ SEL. LINES		
				A	0-10 V		
						Excitation	
						0	None
						1	12 VDC
						2	24 VDC

Basic unit	DC	Range
HK 35	3-1/2 digit	011 200 mV
HK 45	4-1/2 digit	012 2 V
		013 20 V
		014 200 V
		015 750 V

NEMA 4 Cover : Catalog # 45003

Safety Symbols

WARNING

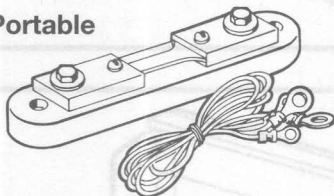
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

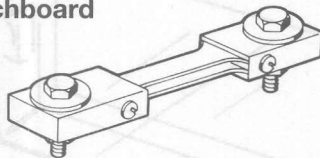
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

Portable



Switchboard



External shunts enable DC Volt digital panel meters to indicate higher DC Currents than can be provided with self contained internal shunt meters. The shunt is installed in series with the load and the source. The shunts provide a DCmV drop which is sent to the display unit. The Hawk can be scaled to display the Current between the load and the source. Simpson manufactures Portable and Switchboard Shunts.

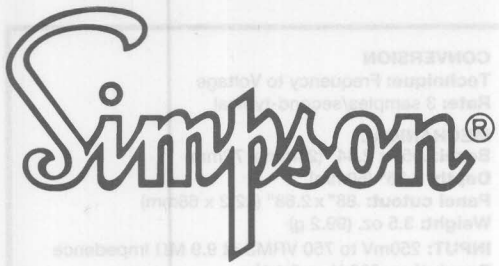
Each shunt includes 5' leads (0.065 Ohm resistance). Accuracy is 1%.

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Switchboard Shunts (50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



Frequency Indicators

MINI-MAX M235 3-1/2 Digit

- **Shallow Depth Indicator! Less Than 2.5" (60 mm) of Space Required Behind the Panel**
- **Fits 3/64 DIN Standard Cutout, 22.2mm x 68mm**
- **Stackable Mounting Bracket Included for Easy Installation**
- **3-1/2 Digit, 0.5" (12.7 mm) High LCD**
- **User Selectable Decimal Point**
- **Optional Negative Image Bright Red Backlighting**
- **Standard Screw Terminals for Easy Installation**
- **2 Frequency Ranges: 20 - 199.9 Hz, 20 - 1999 Hz**
- **120 or 220 VAC power**



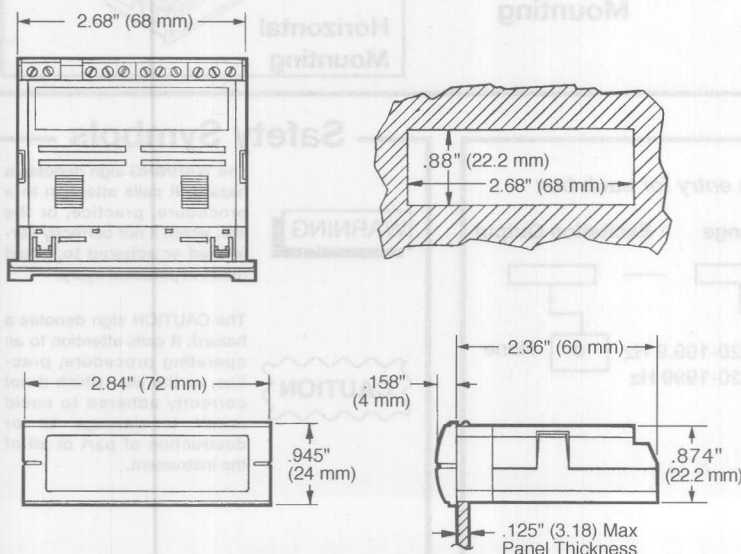
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Simpson's Mini-Max Frequency Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units have 3-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, and screw terminals. Display hold is standard.

A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.

Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: Must be connected by the user on the 200 Hz meter.

Overrange indication: Most significant digit = "1"

Backlighting: Optional negative image, red LED backlighting

POWER REQUIREMENT

120 (90-132) VAC @ 40-440 Hz

220 (180-264 Max.) @ 40-440 Hz

Power Consumption:

3 VA min/12 VA max rate

Rated Circuit to Ground Voltage: 750 VRMS

ACCURACY @ 25°C:

200 Hz: ± 0.5 Hz

2 kHz: ± 5 Hz

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non condensing

Warmup time: Less than 20 minutes

CONVERSION

Technique: Frequency to Voltage

Rate: 3 samples/second-typical

MECHANICAL

Bezel: .95" x 2.84" (24mm x 72mm)

Depth: 2.36" (60mm)

Panel cutout: .88" x 2.68" (22.2 x 68mm)

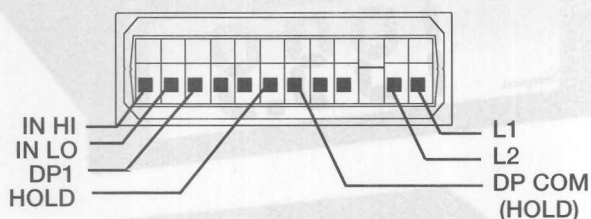
Weight: 3.5 oz. (99.2 g)

INPUT: 250mV to 750 VRMS at 9.9 M Ω Impedance

Resolution: 200 Hz = 0.1 Hz

2 kHz = 1 Hz

M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Wiring Connections

Negative image, bright red LED backlighting is available in the Mini-Max M235. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini-Max, so no additional external power supply is required.

Decimal Point: To select the decimal point, connect the DP pin to the DP/HOLD COMMON.

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

Input Signal: Connect the IN HI and IN LOW to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals.

Decimal Point



Stacking Features

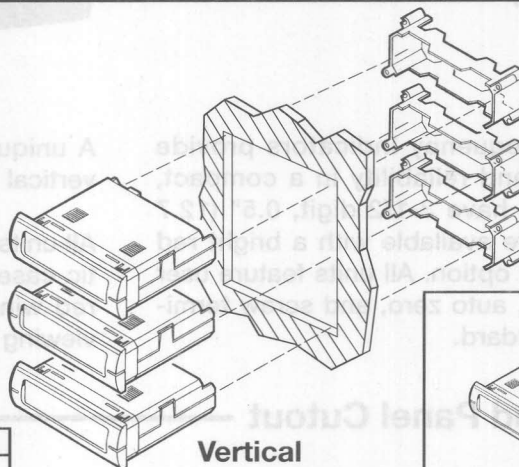
The mounting clips that come with every Mini-Max can be connected together. This allows multiple units to be mounted in one hole. Perfect alignment in the panel can be achieved, as only one hole is made.

Perfect for line monitoring applications, Mini-Max 3 Packs provide reliable Voltage, Current, and Frequency measurement in our most popular ranges. The power requirement is 120 VAC.

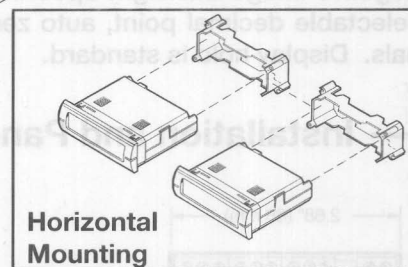
Mounting the three units is quick and easy. Install the bottom unit first. Place the next mounting clip on top of the previous clip, and slide the meter in place. Repeat for the top unit.

3-Pack AC Volt/Frequency/Current Indicators

Catalog No.	Voltage	Frequency	Current	Backlight
M35031	200 V	199.9 Hz	5 A	None
M35131	200 V	199.9 Hz	5 A	Negative Red
M35032	750 V	1999 Hz	5 A	None
M35132	750 V	1999 Hz	5 A	Negative Red



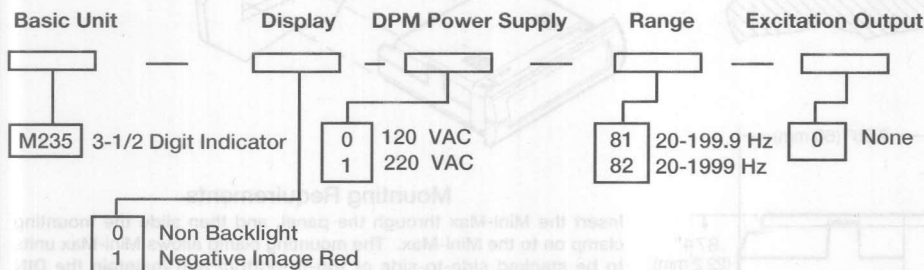
Vertical Mounting



Horizontal Mounting

Ordering Information

Mini-Max Frequency Indicators are configured by making an entry for each box



Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.



Frequency Controllers

Hawk HK40 series 4 Digit

- Easily Programmed From the Front Panel
- Software Functions Include:
 - Password Display Scaling
 - One, or Two Set Points Decimal Point Selection
 - Time Delay & Hysteresis
- Display Hold
- 2 Piece Screw Terminal Connector for Easy Installation
- 1/8 DIN Case Made of High Impact Noryl®
- 2 Frequency Ranges: 15 Hz to 99.99 Hz, and 15 Hz to 999.9 Hz
- Optional Nema 4 Front Panel Cover
- Optional 5 Amp Relays and Analog/Digital Outputs
- 4 digit, 0.5" (14.2 mm) High, Bright Red LED Display



B
1
4
3

Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Display Hold is standard on the Hawk Frequency controller, allowing the operator to freeze the display to take a reading.

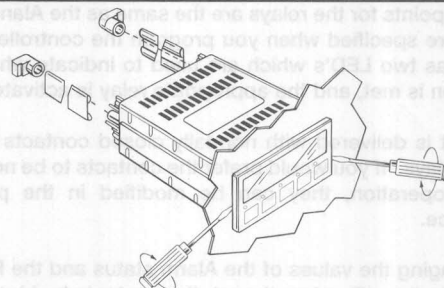
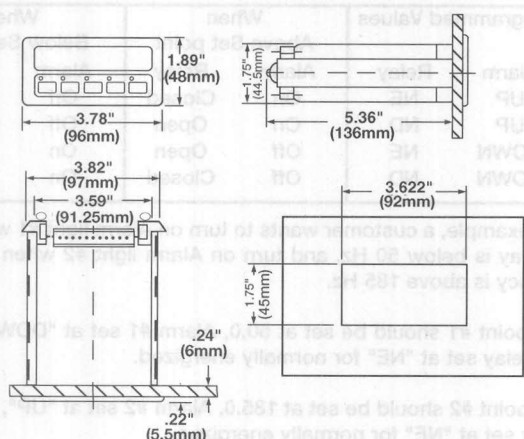
Two optional 5 Amp Relays include front panel programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include

programmable decimal point and a password lockout feature. By using the Password feature, the meter's programming functions and set points are protected from accidental programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl® plastic.

The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2 mm).

Decimal Point: 3 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA max.

ACCURACY @ 25°C:

HK40: 0.02% of input ± 1 digit

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):
 ± 100 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 70 dB (1 K Ω unbalanced) @50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Time Base: 1 Second

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm) 1/8 DIN

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

Case Material: 94 V-1 UL rated Noryl®

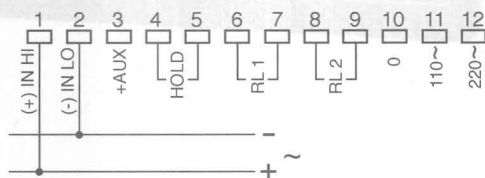
Weight: 16 oz. (453.6 g)

Inputs: Frequency

Input Range	Display Resolution	Input Voltage	Time Base
15 - 99.99Hz	0.01 Hz	9 - 450 V	1 Second
15- 999.9Hz	0.1 Hz	9 - 450 V	1 Second

Impedance: 1M Ω

Wiring Diagram



Input Signal:

Connect the input signal to terminals #1 and #2 as shown in the diagram above.

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Relays

Up to two relays are available for the Hawk controller. The relays are 5 amp, 250 VAC, DPST models. The functions of the relays are defined in the programming mode. The functions include the set point, the alarm level, hysteresis, time delay, and status of each relay.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without soldering or unsoldering them.

The chart to the right shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,
4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on Alarm light #1 when the display is below 50 Hz, and turn on Alarm light #2 when the frequency is above 185 Hz.

Set point #1 should be set at 50.0, Alarm #1 set at "DOWN", and the relay set at "NE" for normally energized.

Set point #2 should be set at 185.0, Alarm #2 set at "UP", and the relay set at "NE" for normally energized.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The ▲ and ▼ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2" LED's will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the ▲ or ▼ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the ▲ or ▼ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" for 1 second, then the stored value will be displayed.

Low Electrical Input

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the ▲ or ▼ keys until the desired value is displayed. Press "ENTER" to lock in the "LoE" value.

High Electrical Input

"HiE" will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the ▲ and ▼ key.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values different from the input value.

For example:

Electrical Input Range : 0 to 99.99 (LoE to HiE)

Programmed Display Scaling: 0 to 100.0% (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To

again, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which we want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-energized ("nd"). Press "ENTER" to store this setting in memory.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

Exiting Programming Mode

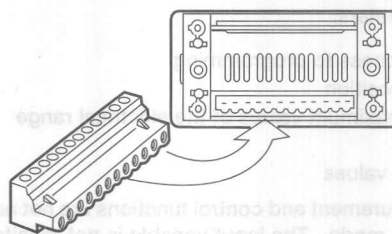
After programming the relay(s), the Hawk will automatically exit the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up. Additional edge connectors are available from your Authorized Hawk distributor.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3V$	$0 \leq +15V$
$1 \leq -3V$	$1 \geq -15V$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5V$	$0 \leq +13V$
$1 \leq -5V$	$1 \geq -13V$

Load Resistance: 3K Ω to 7K Ω

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

Inputs

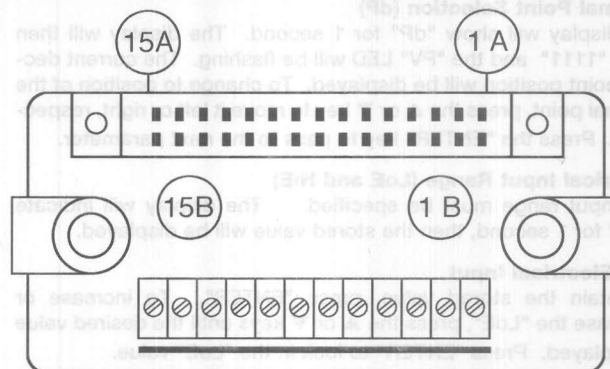
Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2V$ (diff)	$0 \leq +12V$ (diff)
$1 \leq -0.2V$ (diff)	$1 \geq -12V$ (diff)

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5V$ (diff)	$0 \leq +5V$ (diff)
$1 \leq -1.5V$ (diff)	$1 \geq -5V$ (diff)

Termination Resistances : 100 $\Omega \pm 10\%$

(*) Control lines managed by the software, so as to enable the



correct reception of the data transmitted from the Hawk.

CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

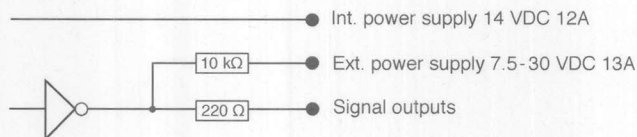
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by creating a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart immediately below for all the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(1sd)	2nd digit	3rd digit	4th digit
Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B
2 2B	20 2A	200 6B	2,000 10B
4 3B	40 3A	400 7B	4,000 11B
8 4B	80 4A	800 8B	8,000 12B

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 22 to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign. Each data group can be selected by means of 3 "Enable" lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A
Ground	10 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mA DC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for DC Voltage controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mA DC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mA DC:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C (HK 35)

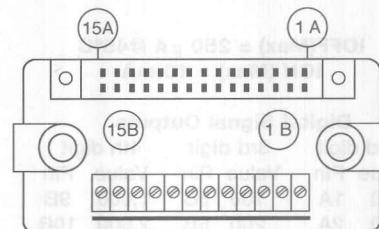
Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

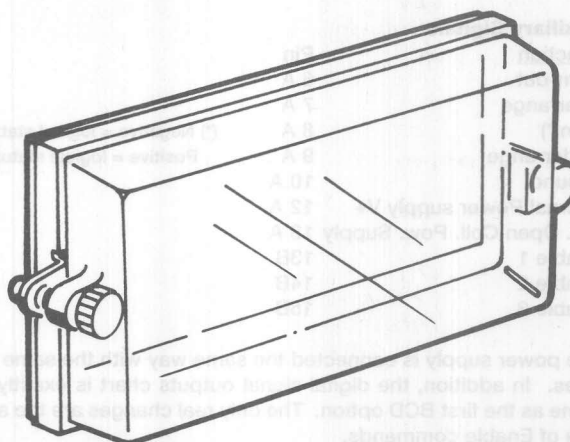


NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, separate the front half from the back half of the cover. Slide the Hawk through the back half, then attach the wiring connections. Install the meter in the panel, sliding the side retainers on so the cover is held between the bezel of the meter and the panel. Make sure the gasket is compressed between the bezel and the panel. Screw the front half of the cover on tightly to compress the other gasket.



Application Example

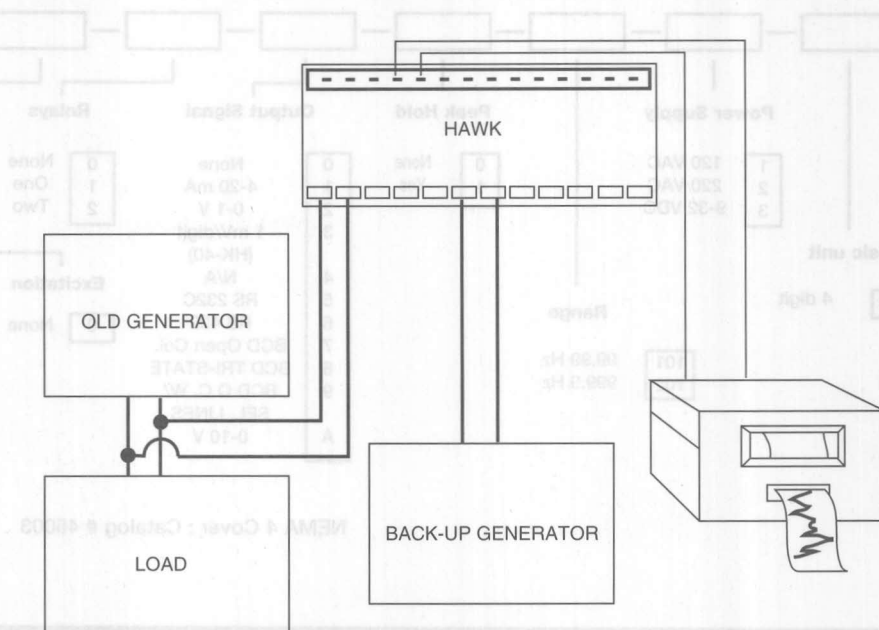
A Maintenance engineer needs to monitor the frequency of the line voltage supplying power to a drying cycle and conveyor motor. If the power fails, the system needs to activate a backup generator to finish the product started in the cycle, taking it through the drying process. The Maintenance engineer wants a relay to activate a back-up generator if the frequency output of the line power falls below 45 Hz. In addition, a notation needs to be kept via a chart recorder of the frequency monitored, requiring a 1 mV/digit output. The 1mV/digit output will make it easy to interpret the markings on the chart paper, and convert the mark to a frequency reading. Finally, a lockout feature is needed so the setpoints can not be changed accidentally.

A Hawk 4 digit frequency controller (0 to 99.99 Hz) with a single relay and 1 mV/digit Analog output can fill the application. No additional display scaling is required, as the meter will display from 15Hz to 99.99 Hz in 0.01 Hz increments.

The meter is installed in parallel between the source (line voltage) and the load (the dryer and conveyor motors) like a volt meter.

The Password lockout feature locks out unwarranted changes in the programming functions which include the set points and the display scaling functions, but allows the operator to check the setpoints (but not change them) via the ▲ and ▼ keys on the front panel.

The Programming mode should contain the following parameters:
 Pas = an appropriate 2 digit password from 0 to 99.
 HiE = 99.99, LoE = 00.00. This sets the input range.



Hi = 99.99, Lo = 00.00. This is the display scaling, allowing the display to indicate different engineering values if desired. In this case, the display will show the correct frequency being monitored by the Hawk.
 SP = 45.00. This is the set point at which the Hawk will activate (or de-activate) the relay and alarm LED indicators.
 Alarm Level = do (for down). This programs the Hawk to activate the relay when the displayed value falls below the set point.
 HYS = 1, delaying the de-energizing of the relay until the display indicates 1% above the set point value. This keeps the second generator turning until the first generator's output is above 46 Hz.
 DEL = 2, for a 2 second time delay. This

allows the generator to fall below 45.00 Hz for two seconds before the back up generator turns on.

Relay Status = "nE" for normally energized. This keeps the relay energized until an alarm condition occurs.

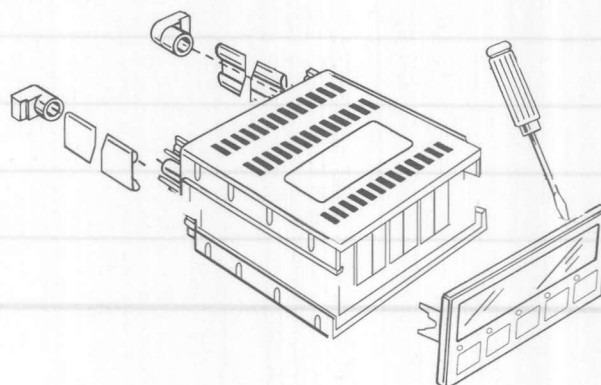
The Relay is connected to the second generator, and will activate when an alarm condition occurs.

The output signal is connected to the chart recorder from terminal points 11 A (Out -) and 12 A (Out +). In an overrange situation, a 5 VDC signal is available from pin 7A, and an underrange signal of 0 VDC is available from pin 9 A.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first. Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case.

Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.



Ordering Information

Basic unit		Power Supply		Peak Hold		Output Signal		Relays		Excitation	
HK 40 4 digit		1 120 VAC 2 220 VAC 3 9-32 VDC		0 None 1 Yes		0 None 1 4-20 mA 2 0-1 V 3 1 mV/digit (HK-40) 4 N/A 5 RS 232C 6 RS 422 7 BCD Open Col. 8 BCD TRI-STATE 9 BCD O.C. W/ SEL. LINES A 0-10 V		0 None 1 One 2 Two		0 None	
Range		101 99.99 Hz 102 999.9 Hz									

NEMA 4 Cover : Catalog # 45003

Safety Symbols

WARNING

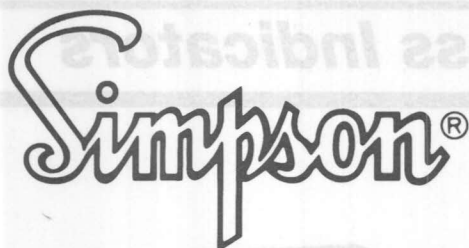
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Engineers Notes

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Process Indicators



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From compact 3/64 DIN mini indicators to 1/8 DIN controllers, Simpson offers a wide range of digital meters to fit your application requirements.

Panel Cutout and Displays

Simpson's line of Process indicators/controllers are available in 3 different panel cutout sizes. The Mini-Max indicators are 3/64 DIN, offering compact size with a large 0.5" LCD display. An optional negative image, red backlight LCD display is available for all the Mini-Max indicators. The Falcon indicators and Hawk/Hawk II controllers are 1/8 DIN size, and both styles have 0.56" LED displays. The 2800 series indicators require a 92mm by 42.72 mm cutout, and offer the same 0.56" LED display.

Process Measurement

All of the 1/8 DIN indicators/controllers and the Mini-Max have a 4-20 mA range, which allows you to use a variety of transmitters with the unit. Transmitters typically take in an electrical signal, such as 0-50 mV, and emit a 4-20 mA signal to a Process indicator or controller. The 4-20 mA signal is superior in travelling longer distances than a small Voltage signal. This allows remote monitoring of a process, which is an advantage if you are setting up a control room for your facility. Simpson carries a line of isolated and non-isolated

and emit a 4-20 mA signal to any of our Process meters. All of the 1/8 DIN meters and the Mini-Max can be scaled in the field to any engineering unit. This allows you to change the display from Fahrenheit to Celsius, or any other type of measurement you desire. The 2800 series is sent out ready to display 0-100%.

Excitation Outputs

Excitation output is available in the Mini-Max and Falcon indicators, and in the Hawk/Hawk II controllers. A choice of 12 or 24 VDC is offered in these units.

Power Supply

All units feature 120/220 VAC power supply. The 2800 series have an optional 5 VDC power supply, and the Mini-Max offers a choice of 12/24/48 VDC power supply. The Falcon indicators and Hawk controllers have an optional 9-32 VDC power supply, and the Hawk/Hawk II controllers have an optional 24/48 VAC power supply.

Screw terminals are standard on the Falcon, Mini-Max, and Hawk series indicators/controllers. This makes it very easy to connect the wiring to the meter, reducing change over time from a defective meter to one of Simpson's digital meters.

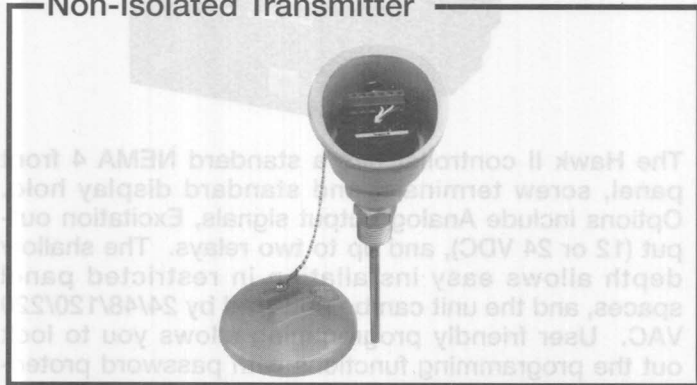
Display Hold

Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the DC Current signal.

Relays, Analog and Digital Outputs

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in either the Hawk or Hawk II controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are available in both the Hawk and Hawk II controllers. The Hawk II has Analog output signals (4-20 mA, 0-1 V, and 0-10 V signals). The Hawk offers Analog or Digital output signals, such as RS 232/RS 422, as well as BCD output signals.

Non-Isolated Transmitter



lated transmitters for temperature applications. These units take in a thermocouple signal (typically 0-50 mV),



Process Indicators

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With a 3/64 DIN cutout and 60 mm depth, Mini-Max fits small spaces easily. Available in 3-1/2 or 4-1/2 digit LCD display, or an optional negative image, red back-light display. A unique mounting bracket allows easy stacking of multiple units in one panel cutout, eliminating the need to tap multiple holes. Screw terminals are standard for easy wiring installation. Offset and display scaling can be done in the field.



The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. Jumper selectable decimal point allows flexibility of this meter in your application. These units are shipped ready to display 0-100%, and can be modified by the factory for other display ranges.



Falcon F35 low cost indicators can monitor Process signals, and offer broad range scaling to any engineering unit. Offset scaling is easily accessed in the Falcon F35. The F35 can be modified in the field to accept a different range by moving selected jumpers on the main board. Decimal point selection can be made behind the front bezel or from the screw terminal connector on the rear.



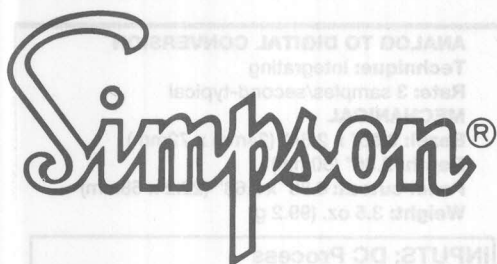
The Falcon F45 uses a precision microprocessor design to monitor Process signals. The high quality, 4-1/2 digit display can be protected by an optional NEMA 4 cover. Range selection and decimal point can be changed in the field by jumpers on the main board. In addition, the display can be easily scaled to any engineering unit you want. Offset scaling is standard in the Falcon F45.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include dual relays, and Analog/Digital output signals. Excitation outputs (12 or 24 VDC) are available for powering transmitters and other accessories. An optional 9-32 DC power supply is available for the Hawk controller.



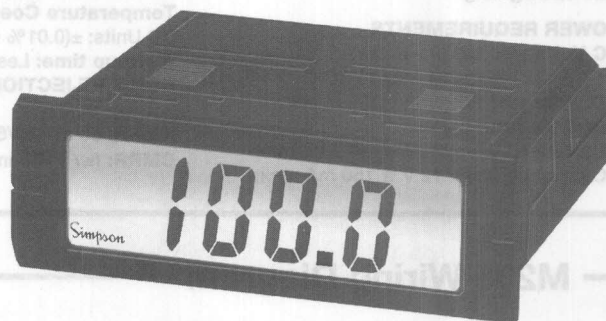
The Hawk II controller has a standard NEMA 4 front panel, screw terminals, and standard display hold. Options include Analog output signals, Excitation output (12 or 24 VDC), and up to two relays. The shallow depth allows easy installation in restricted panel spaces, and the unit can be powered by 24/48/120/220 VAC. User friendly programming allows you to lock out the programming functions with password protection.



DC Process Indicators

MINI-MAX M235 & M245 Series 3-1/2 & 4-1/2 Digit

- **Shallow depth indicator! Less than 2.5" (60 mm) of space required behind the panel**
- **Fits 3/64 DIN standard cutout, 22.2mm x 68mm**
- **Stackable mounting bracket included for easy installation**
- **3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) high LCD**
- **User selectable decimal point**
- **Broad range display scaling and adjustable offset**
- **Optional negative image bright red backlighting**
- **Standard screw terminals for easy installation**
- **4 Process ranges: 4-20 mA, 1-5 VDC, 0-10 VDC, 0-100 VDC**
- **120/220 VAC, or 12/24/48 VDC isolated power**



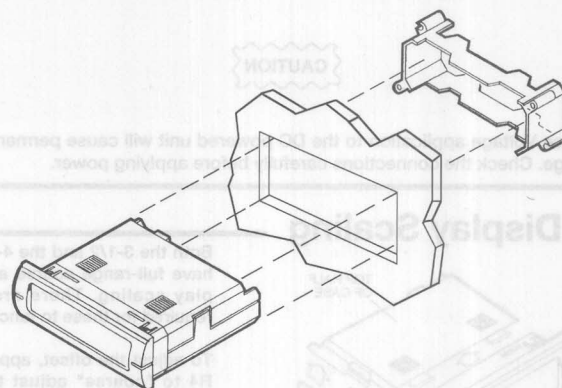
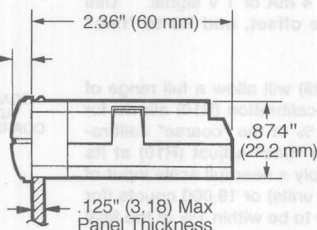
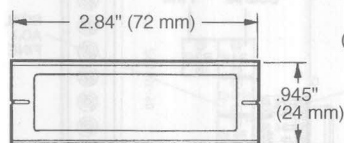
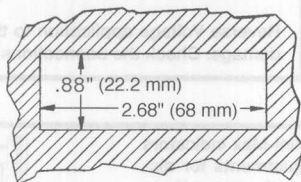
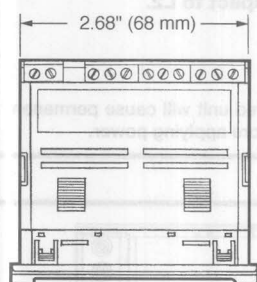
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Simpson's Mini-Max Process Indicators provide high quality, accuracy and reliability in a compact, 60mm deep case! Units offer choice of 3-1/2 or 4-1/2 digit, 0.5" (12.7 mm) LCD display and are available with a bright red negative image backlight option. All units feature user selectable decimal point, auto zero, zero offset and scaling capabilities. Display hold is option-

ally available for the 4-1/2 digit units. A unique mounting bracket is provided to allow for vertical or horizontal stacking of multiple indicators.

All Mini-Max units feature a standard 3/64 DIN high impact plastic case. The negative image red backlit units have a red window, and the non-backlit units have a clear viewing window.

Installation and Panel Cutout



Mounting Requirements

Insert the Mini-Max through the panel, and then slide the mounting clamp on to the Mini-Max. The mounting clamp allows Mini-Max units to be stacked side-to-side or top-to-bottom and maintain the DIN standard panel arrangements in 24mm by 72mm multiples.

Specifications

DISPLAY

Type: LCD

Height: 0.5" (12.7mm)

Decimal point: 3 position programmable (3-1/2) or 4 position programmable (4-1/2)

Overrange indication: Most significant digit = "1"

Backlighting: Optional negative image, red LED backlighting

POWER REQUIREMENTS

AC Voltages: 120 (90-132) VAC @40-440 Hz
220 (180-264 Max.) VAC @40-440 Hz

DC Voltages: 12/24/48 VDC ($\pm 10\%$)

Power Consumption:

AC powered units: 3 VA min/12 VA max

DC powered units: 12 V @ 150 mA max;

24 V @ 80 mA max; 48 V @ 50 mA max.

Rated Circuit to Ground Voltage: 750 VRMS

ACCURACY @ 25°C

M235: $\pm(0.1\%$ of reading + 1 count)

M245: $\pm(0.02\%$ of reading + 1 count)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non condensing

Temperature Coefficient:

DC Units: $\pm(0.01\%$ of input ± 0.05 count)/°C

Warmup time: Less than 20 minutes

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/ 1 K Ω unbalanced @ 60 Hz): 90 dB min

ANALOG TO DIGITAL CONVERSION

Technique: Integrating

Rate: 3 samples/second-typical

MECHANICAL

Bezel: 0.95" x 2.84" (24mm x 72mm)

Depth: 2.36" (60mm)

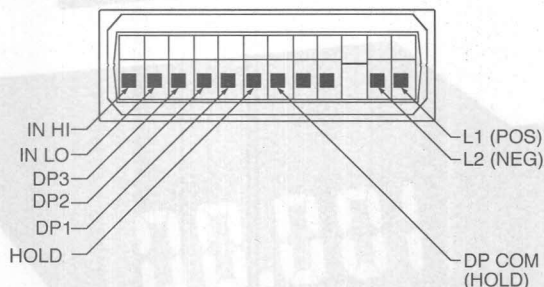
Panel cutout: 0.88" x 2.68" (22.2 x 68mm)

Weight: 3.5 oz. (99.2 g)

INPUTS: DC Process

Range	Resolution M235	Resolution M245	Voltage Drop	Max Input (unfused)
4-20 mA	10 μ A	1 μ A	200 mV	100 mA
Range	Resolution M235	Resolution M245	Input Impedance	Maximum Input
1-5 VDC	10 mV	1 mV	10 M Ω	750 V
0-10 VDC	10 mV	1 mV	10 M Ω	750 V
0-100 VDC	100 mV	10 mV	10 M Ω	750 V

M235 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, or DP3) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open).

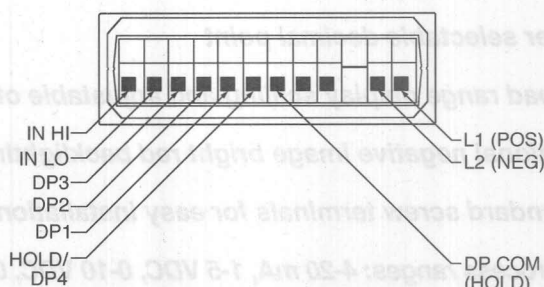
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

M245 Wiring Diagram



WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point: To select a decimal point, connect the appropriate DP pin (DP1, DP2, DP3, or DP 4) to the DP/HOLD COMMON. Unused DP inputs may remain unconnected (open).

Reading Hold: Connect Hold to DP/HOLD COMMON. If this feature is not required, the HOLD pin may remain unconnected (open). Hold is optional with the 4-1/2 digit Mini-Max, and when so equipped replaces DP4. Available through our modification centers.

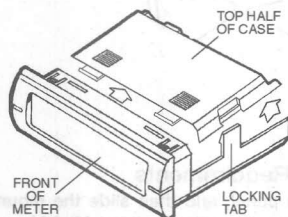
Input Signal: Connect the IN HI and IN LO to the signal to be monitored.

Supply Power: Connect the power to the L1 and L2 terminals. For AC powered units, L1 and L2 are not polarized. For 12, 24, or 48 VDC units, L1 must be positive with respect to L2.

CAUTION

Reverse Voltage application to the DC powered unit will cause permanent damage. Check the connections carefully before applying power.

Display Scaling

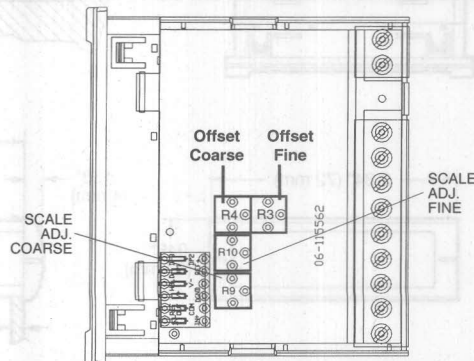


Using a screwdriver or thumbnail, spread tab on each side of case to unlock top half. Lift rear of top half and slide away from front of meter.

Both the 3-1/2 and the 4-1/2 digit Mini-Max indicators have full-range coarse and fine adjustments for display scaling. There are no optional connections required for these to function.

To adjust the offset, apply 4 mA or 1 V signal. Use R4 to "coarse" adjust the offset, and R3 to "fine" adjust the offset.

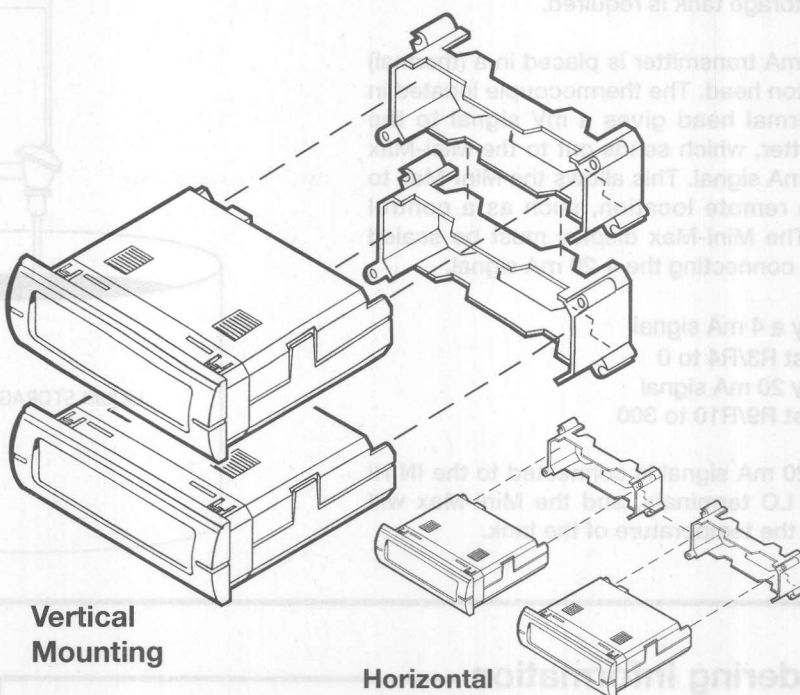
The "coarse" calibration (R9) will allow a full range of scaling values. The "fine" calibration (R10) allows for an approximate range of 1% of the "coarse" calibration. Begin by placing the "fine" adjust (R10) at its center of rotation. Then apply a near full scale input of either 1,900 (for 3-1/2 digit units) or 19,000 counts (for 4-1/2 digit units). Adjust R9 to be within 1% of the final value, then use R10 to obtain the final desired result.



Stacking Features

The mounting clips that come with every Mini-Max can be connected together. This allows multiple units to be mounted in one hole (no need to punch one hole per meter). Perfect alignment in the panel can be achieved, as only one hole is made.

For DC applications, Mini-Max 2-Packs provide economical and reliable voltage and current measurement capabilities in our most popular ranges. The power requirement is 120 VAC. Mounting the two units is very simple. The bottom unit is installed first, then the mounting clip is attached to the top of the bottom unit. Finally, the top meter is installed into the top clip.

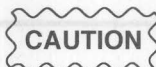
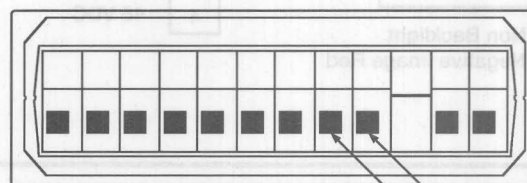


2-Pack DC Voltage/Current Indicators

Catalog No.	Voltage	Current	Backlight
M35021	2V	200 mA	None
M35022	20V	2 A	None
M35122	20V	2 A	Negative Red
M35023	200V	5 A	None
M35123	200V	5 A	Negative Red

Excitation Output

Excitation output is optionally available in the Mini-Max for powering external transmitters or transducers. Excitation is available from the EX POS and EX NEG terminals. This source is isolated from the measurement input as well as the input power circuits. The voltage available is 12 VDC with a maximum load current of 20 milliamps. This feature eliminates the need to mount an external DC power source for transducers or sensors used in your application.



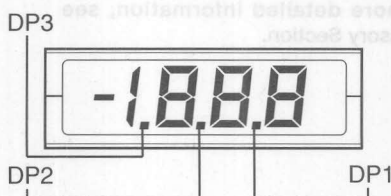
Do not exceed an excitation load current of 20 mA!

EX NEG
EX POS

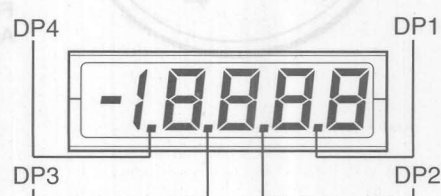
Backlight Option

Negative image, bright red, LED backlighting is available in the Mini-Max M235 and M245. This will illuminate the display allowing the unit to be read in low light areas. Backlighting power is supplied by the Mini Max, so no additional external power supply is required.

Decimal Point 3-1/2



Decimal Point 4-1/2



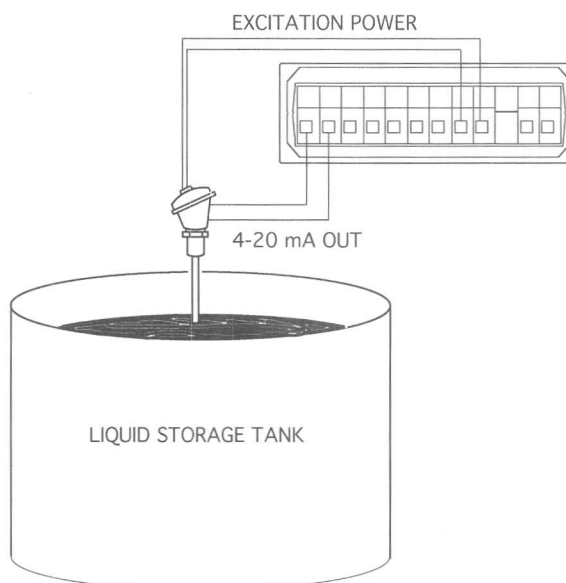
Application Example

Remote temperature (0-300°) monitoring of a liquid storage tank is required.

A 4-20 mA transmitter is placed in a (thermal) protection head. The thermocouple located in the thermal head gives a mV signal to the transmitter, which sends out to the Mini-Max a 4-20 mA signal. This allows the Mini-Max to be in a remote location, such as a control room. The Mini-Max display must be scaled prior to connecting the 4-20 mA signal.

1. Apply a 4 mA signal
2. Adjust R3/R4 to 0
3. Apply 20 mA signal
4. Adjust R9/R10 to 300

The 4-20 mA signal is connected to the IN HI and IN LO terminals, and the Mini-Max will display the temperature of the tank.



Ordering Information

Your Mini-Max Current Indicator can be configured by making an entry for each box

Basic Unit	Display	DPM Power Supply	Range
M235 M245	3-1/2 Digit Indicator 4-1/2 Digit Indicator	0 1 2 3 4	71 72 73 74
0 1	Non Backlight Negative Image Red	120 VAC 220 VAC 12 VDC 24 VDC 48 VDC	4-20 mA 1-5 VDC 0-10 VDC 0-100 VDC

Safety Symbols

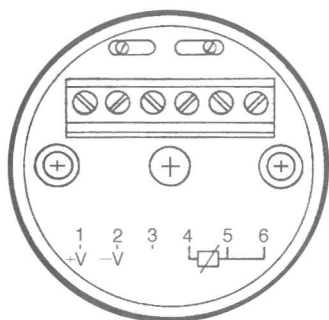
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories



Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.

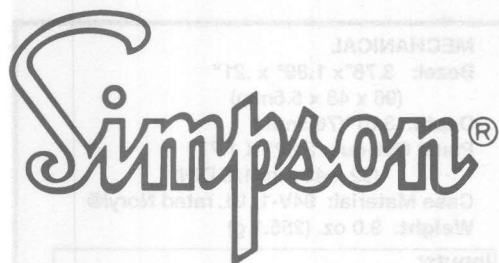
Thermocouples are also available through Simpson. J, K, T, E, and RTD sensors are available in custom lengths to fit your application.

For more detailed information, see Accessory Section.

Transmitter Ordering Procedure (TR700 & TR800)

INPUT TYPE	TC TYPE	UNITS (Measurement)	INPUT SENSOR RANGE (MV or Temperature)
1 2 3	0 1 2 3 4 5 6 7	1 2 3	ex. 0 - 300

Indicates Span Range

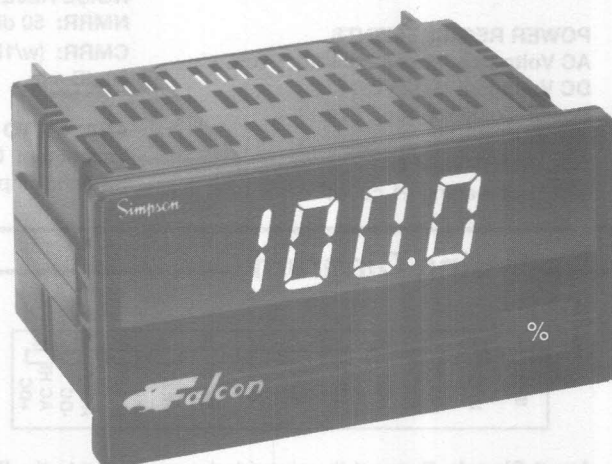


DC Process Indicators

Falcon F35 Series 3-1/2 Digit

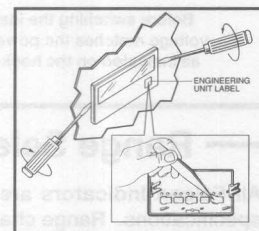
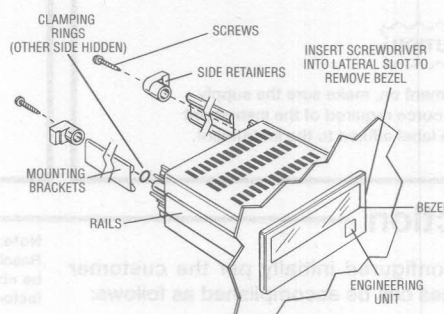
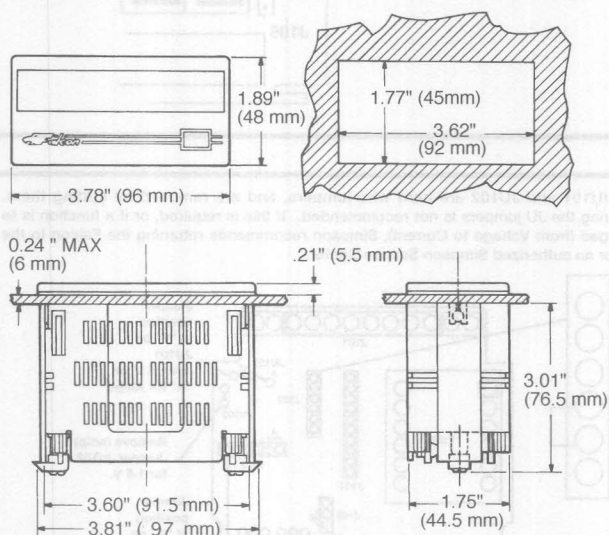
- Full 3-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling to any Engineering Units and Zero Offset
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 3 User Selectable Ranges: 4-20 mA, 1-5 V, 0-10 V
- Jumper Selectable Decimal Point
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply
- Optional Excitation Output of 12 VDC or 24 VDC

The Falcon Series digital indicators are premium quality 1/8 DIN meters for industrial applications with display scaling capability. All Falcon units feature jumper selectable decimal point (internal and on the connector for remote decimal point), providing wide application flexibility. In addition, it is very easy to change the signal input range with jumpers on the main board. The Falcon has a 0.56" bright red LED



display for high visibility and an optional NEMA 4 cover to protect the display in washdown environments. Compactly designed for applications requiring minimal rear panel depth, the Falcon fits a standard 1/8 DIN panel cutout (92mm x 45mm) and requires only 3.01" behind the panel. A screw terminal connector is a standard feature for easy wiring of the power supply and signal input connections.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove the screws, side retainers, and mounting brackets from the rails as shown above. Position the Falcon into the cutout. From the rear of the panel, slide the panel mounting brackets back onto the rails until the brackets are flush against the back of the panel. Replace the side retainers and screws.

Engineering Label Placement

If replacement of the engineering unit label is required, insert a small screwdriver into the lateral slot on side of bezel and gently turn the screwdriver until the bezel snaps away from the case. Use tweezers to remove and replace the engineering unit label. Gently snap the bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED
Height: 0.56" (14.2mm)
Decimal Point: 3 position programmable, internally or on the terminal block.
Overrange indication: 3 least significant digits blank, above 1999 counts.
Polarity: Automatic, with "-" indication, "+" indication implied.
Span: User adjustable up to 1999 counts.

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$
DC Voltages: 9-32 VDC
Power Consumption: 3VA

ACCURACY @25° C

$\pm 0.1\%$ of reading ± 1 count

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -10 to 60°C
Relative Humidity: 0 to 85% non-condensing
Temperature Coefficient:
 $(\pm 0.01\%$ of input ± 0.05 count)/°C
Warm-up Time: Less than 15 minutes
Response Time: Less than 1 second

NOISE REJECTION

NMRR: 50 dB, 50/60 Hz
CMRR: (w/1K Ω unbalanced @ 60 Hz): 90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration
Rate: 3 samples per second, nominal

MECHANICAL

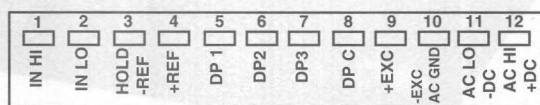
Bezel: 3.78"x 1.89" x .21"
 (96 x 48 x 5.5mm)
Depth: 3.01"(76.5mm)
Panel Cut-out: 3.62" X 1.77"
 (92 x 45 mm 1/8 DIN)
Case Material: 94V-1, UL rated Noryl®
Weight: 9.0 oz. (255.1 g)

Inputs:

DC Process

Input Range	Display Resolution	Voltage Drop	Max. Overload
4-20 mA	10 μ A	0.2 V (Input Impedance)	100 mA
1-5 V 0-10 V	10 mV 10 mV	10 M Ω 10 M Ω	100 V 100 V

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. IN HI is terminal #1, IN LO is terminal #2.

Supply Power: Connect the supply power to terminals #11 and #12. Note that if AC power is supplied, terminal #11 is for neutral, and terminal #12 is for hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch can be used to make the connection. To activate the display hold, short terminal blocks #3 and #4 (Hold Ref and +Ref).

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

CAUTION

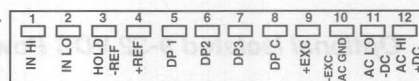
Before switching the instrument on, make sure the supply voltage matches the power source required of the instrument as indicated on the hook-up label affixed to the instrument.

Decimal Point Selection

From terminal block: The decimal point can be set from the rear screw terminal block by connecting the appropriate decimal point (DP 1, 2, or 3) to the DP C terminal. The J105 jumper must be in the D position (see diagram below).

Decimal Point

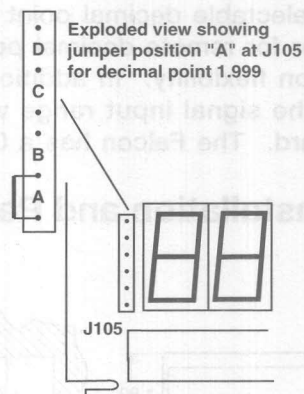
Point	Connect
1.999	DP C to DP1
19.99	DP C to DP2
199.9	DP C to DP3
1999	No Decimal



From front panel: The decimal point can also be selected by removing the front bezel from the meter. Move the push-on jumper J105 across the correct letter.

Decimal Point

Point	Jumper Position at J105
1.999	A
19.99	B
199.9	C
1999	D



Range Selection

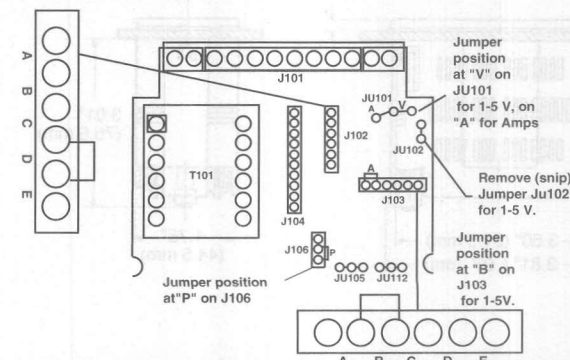
All Falcon Indicators are configured initially per the customer specifications. Range changes can be accomplished as follows:

Remove the screws, brackets, and side retainers from the unit. Next, remove the O-rings from the two rear posts where the brackets are screwed in. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

If a new range is selected, the calibration procedure must also be performed. See the chart below for jumper locations.

Range	J102	J106	JU101	JU102
4-20 mA	D	P	A	No
Range	J103	J106	JU101	JU102
1-5 V	B	P	V	No
0-10 V	B	P	V	No

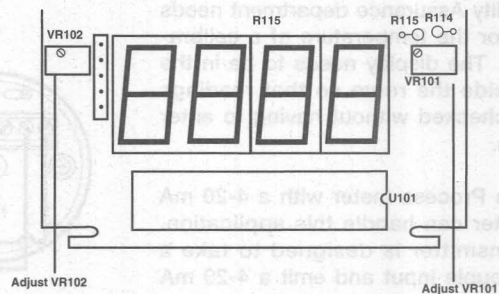
Note: JU101 and JU102 are hard wire jumpers, and are removed by cutting them. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed (from Voltage to Current), Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center.



Display Scaling and Zero Offset

The Falcon can be easily scaled to display any engineering unit. For example, if a 4-20 mA signal is being monitored, and you want the meter to display 0-100%:

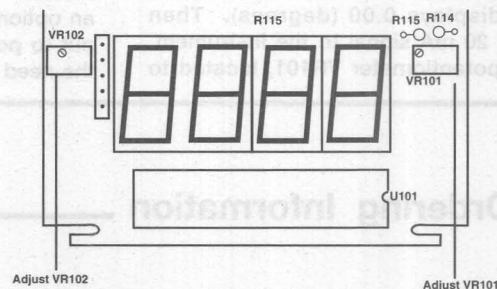
- 1) Remove the front bezel with a small screwdriver.
- 2) Apply a 4 mA signal to terminals #1 and #2, and adjust potentiometer VR102, located to the left of the display, until the meter displays 0.00 (%).
- 3) Apply the maximum signal input to terminals #1 and #2 (20 mA).
- 4) Adjust potentiometer VR101 until the meter displays the maximum reading desired (100.0%).
- 5) Replace the bezel carefully. The meter will now indicate 0% at 4 mA, and 100% at 20 mA.



Calibration

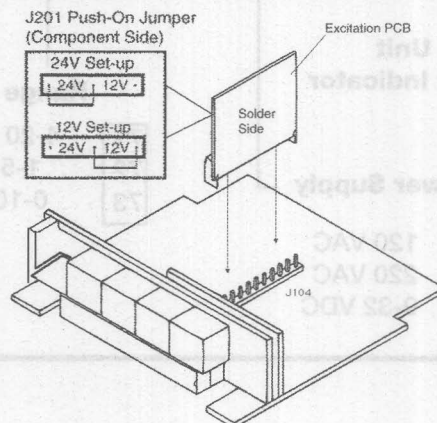
The Falcon is calibrated at the factory per order. If you change the range, and have moved the jumpers, your Falcon will need to be recalibrated.

- 1) Remove the bezel with a small screwdriver.
- 2) Apply the correct minimum value (4mA, 1 V or 0 V) to the instrument and adjust VR102 (left side of display) until the meter displays 4.00, 1.00, or 0.00 (desired minimum display value).
- 3) Apply the maximum input signal to the instrument.
- 4) Adjust the potentiometer (VR101) located on the right side of the display board until the meter displays the value of the input signal or desired maximum display value. For example, if a 20 mA signal is applied, adjust the potentiometer until the display indicates 19.99 (mA).
- 5) Replace the bezel carefully, and install the meter.



Excitation Output

An optional feature of the Falcon is the 12VDC or 24 VDC Excitation output. The Falcon is set at the factory per your order to include an Excitation plug-in printed circuit board in the range you specify. Excitation supply allows you to power external transmitters and transducers without having to set up additional DC power sources for them. If your application changes, you can easily change the Excitation value. The Excitation supply can be reconfigured by moving push-on jumper J201 (located on the Excitation board). To change the excitation output value, move the jumper to the correct position shown in the diagram.

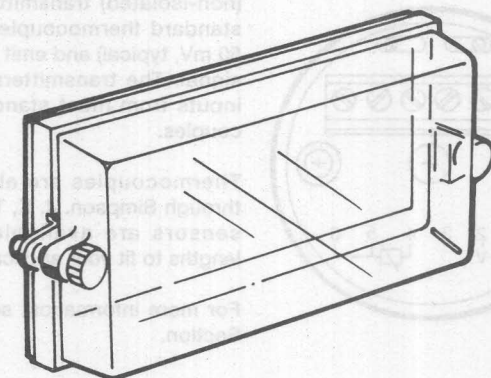


Nema 4 Cover

An optional NEMA 4 cover is available for use with all Falcon series indicators. This cover will help protect the meter in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

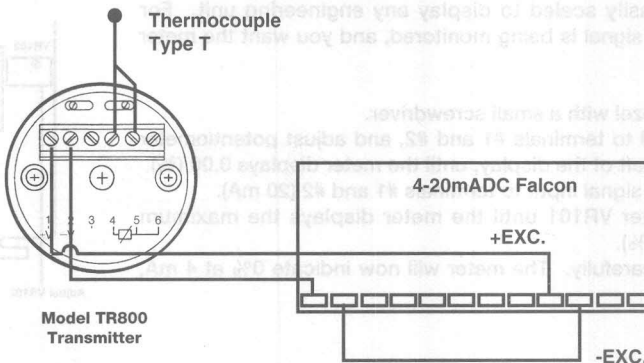
To install the cover, slide the Falcon through the gasket and install the meter into the panel. Then attach the front part of the NEMA 4 cover. Screw the cover on tightly, compressing the gasket about 75%.



Application Example

The Quality Assurance department needs to monitor the temperature of a calibration lab. The display needs to be in the hall outside the room so that readings can be checked without having to enter the room.

A Falcon Process meter with a 4-20 mA transmitter can handle this application. The Transmitter is designed to take a thermocouple input and emit a 4-20 mA signal. By ordering a 0-100° F transmitter with a type T thermocouple, the temperature can be easily measured.



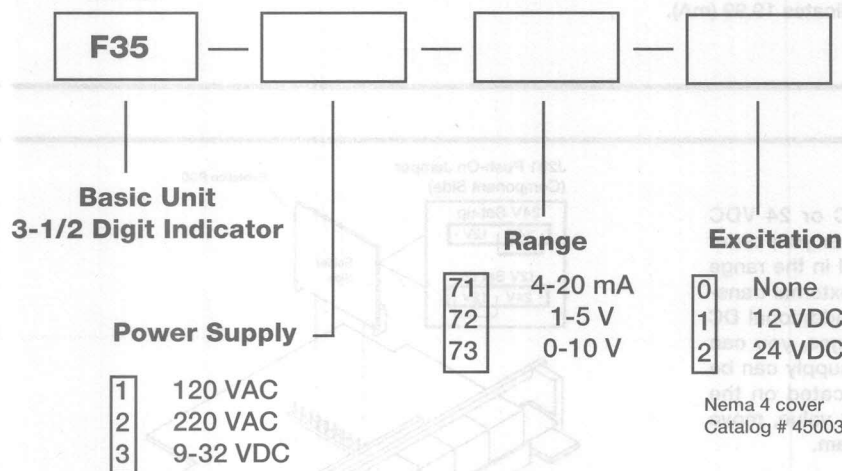
The Falcon meter should be scaled before it is connected to the Transmitter. Apply a 4 mA signal to the instrument and adjust potentiometer VR102 until the meter displays 0.00 (degrees). Then apply a 20 mA signal to the instrument. Adjust potentiometer VR101, located to

the right of the display, until the meter indicates 100.0 (degrees). Consult the factory for resistor values required. Carefully put the bezel back on the meter. Remove the signal input. The Falcon has an optional 12 or 24 VDC Excitation output to power the transmitter, eliminating the need to mount an external DC power

source for the Transmitter.

The Thermocouple is suspended in the room, and connected to the transmitter. The Transmitter is attached to the Falcon, and the Falcon is mounted in a box in the hall. The meter will now indicate 0-100°, monitoring the temperature in the calibration lab.

Ordering Information



Safety Symbols

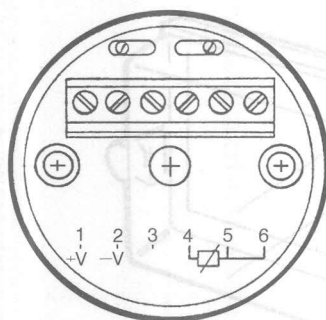
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

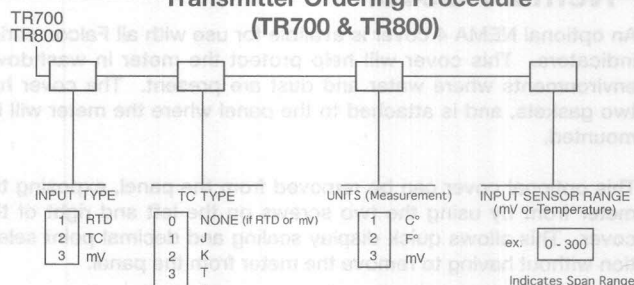


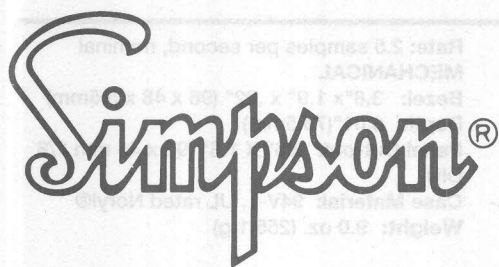
Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.

Thermocouples are also available through Simpson. J, K, T, E, and RTD sensors are available in custom lengths to fit your application.

For more information, see Accessory Section.

Transmitter Ordering Procedure (TR700 & TR800)





DC Process Indicators

Falcon F45 Series 4-1/2 Digit

- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Broad Range Scaling and Offset to Any Engineering Units
- Precision Microprocessor Design
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- 3 DC Process Ranges: 4-20mA, 1-5 VDC, and 0-10VDC
- Optional NEMA 4 Splash Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply
- Optional Excitation Output of 12V or 24VDC

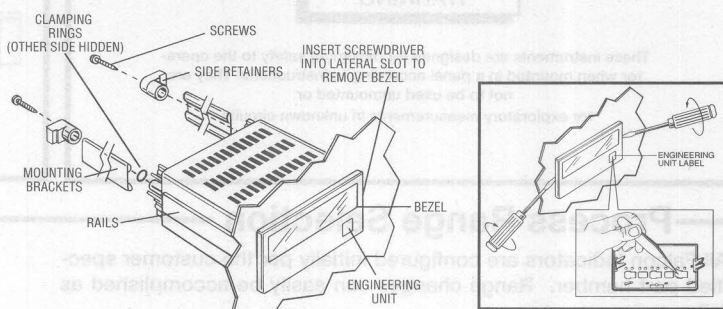
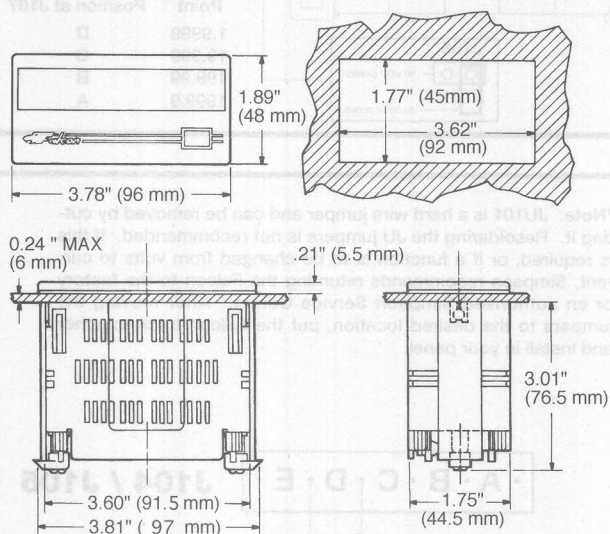


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The Falcon Series digital indicators are premium quality 1/8 DIN meters for rough industrial applications with multi-function and range capability. All DC Process units feature display scaling, adjustable offset, and selectable decimal point providing the ultimate in application flexibility. The meter is designed to operate from either 120 VAC, 220 VAC (50 to 400

Hz), or 9 to 32 VDC. For high visibility, the Falcon has a 4-1/2 digit 0.56" bright red LED display and uses precision circuitry to provide a basic accuracy of 0.02% ± 1 digit for DCV inputs and .05% ± 1 digit for DCA input. A screw type terminal block is provided standard for easy installation and a NEMA 4 splash-proof lens cover is available for wash down areas.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: 4 position programmable internally or at terminal block

Overrange indication: 1 and 4 LSD blank with polarity sign.

Polarity: Automatic, with "-" indication, "+" indication implied.

Span: User selectable-19999 to +32563 with a scale factor 6 maximum.

Scale Factor:

$$M = \frac{\text{Hi-Lo}}{\text{HiE-LoE}}$$

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC; 9V -1% and 32+1%

Power Consumption: 2VA

ACCURACY @25° C

$\pm 0.02\%$ of input ± 1 count (DCV inputs)

$\pm 0.05\%$ of input ± 1 count (DCA input)

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Temperature Coefficient:

$\pm 0.005\%$ of input ± 0.1 digit/°C (DCV inputs)

$\pm 0.01\%$ of input ± 0.1 digit/°C (DCA input)

Warm-up Time: Less than 15 minutes

Response Time: Less than 1 second

NOISE REJECTION

NMRR: 60 dB, 50/60 Hz

CMRR: (w/1k Ω unbalance @ 60 Hz):

90 dB min.

ANALOG TO DIGITAL CONVERSION

Technique: Dual slope integration

Rate: 2.5 samples per second, nominal

MECHANICAL

Bezel: 3.8"x 1.9" x .22" (96 x 48 x 5.5mm)

Depth: 3.01" (76.5mm)

Panel Cut-out: 3.6" X 1.8" (92 x 45 mm 1/8 DIN)

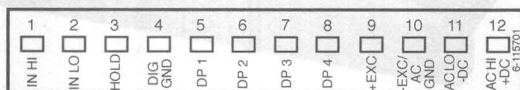
Case Material: 94V-1, UL rated Noryl®

Weight: 9.0 oz. (255.1 g)

Inputs: DC Process

Input Range	Display Resolution	Voltage Drop	Max. Overload
4-20 mA	1 μ A	0.2 V (Input Impedance)	100 mA
1-5 V 0-10 V	1 mV	10 M Ω 10 M Ω	100 V 100 V

Wiring Diagram



Input Signal: Connect the signal to be monitored to the IN HI and IN LO terminals. These are terminals #1 and #2.

Supply Power: Connect the power to terminals #11 and #12. Note that if AC power is applied, terminal #11 is for neutral, and terminal #12 is for hot. If DC power is used, terminal #11 is for -DC, and #12 is for +DC.

Display Hold: This feature allows you to hold the displayed value indefinitely. A remote switch or computer, etc. can be used to activate this feature. To install this feature, short circuit terminal block J112, Pins 3 and 4 (Hold and DIG GND).

WARNING

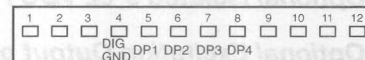
These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Decimal Point Selection

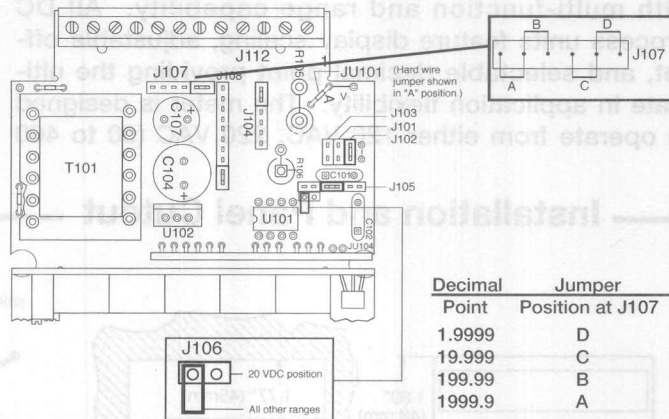
From terminal block J112: The decimal point can be set from the rear screw terminal block J112. Connect the appropriate DP point (DP 1, 2, 3, 4) to the DIG GND terminal. Internal jumper (J107) should be removed and stored on the last contact of J107.

Decimal Point

Point	Connect
1.9999	DIG GND to DP1
19.999	DIG GND to DP2
199.99	DIG GND to DP3
1999.9	DIG GND to DP4



From main board: The decimal point can also be selected by removing the top half of meter case. Move the push-on jumper J107 across the correct letter.



Decimal Point	Jumper Position at J107
1.9999	D
19.999	C
199.99	B
1999.9	A

Process Range Selection

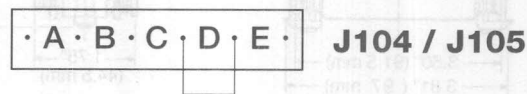
All Falcon Indicators are configured initially per the customer specified part number. Range changes can easily be accomplished as follows:

Remove the brackets and sliding rails from the unit. Next, remove the O-rings on the rear bracket mounts. Remove front bezel. Finally, remove the top half of the Falcon case. The selections are made on the main board.

Note: If a new range is selected, the calibration procedure must also be performed. Only perform this section if a different function or range is required.

4-20mA					
J104 Push-on Jumper			JU101 Jumper Position		
D			A		
1-5 VDC or 0-10 VDC					
J105	J106	J101	J102	J103	JU101*
PJ	PJ	PJ	PJ	PJ	Jumper Position
B	YES	YES	NO	NO	V

*Note: JU101 is a hard wire jumper and can be removed by cutting it. Resoldering the JU jumpers is not recommended. If this is required, or if a function is to be changed from volts to current, Simpson recommends returning the Falcon to the factory or an authorized Simpson Service Center. After moving the jumpers to the desired location, put the Falcon back together and install in your panel.



Example: 4-20mA input

Display Scaling

The Falcon display can be easily scaled to display any engineering unit. Remove the front bezel with a small screwdriver. The scaling procedure is performed at terminal J1 located on the left side of the display board. There are four sets of pins on J1 as shown in the drawing. Each group of pins programs a particular parameter of the scaling procedure when a push-on jumper (supplied with Falcon) is momentarily placed across a set of pins.

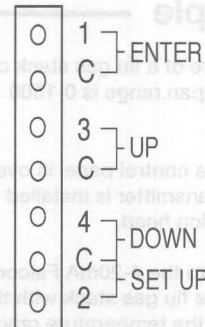
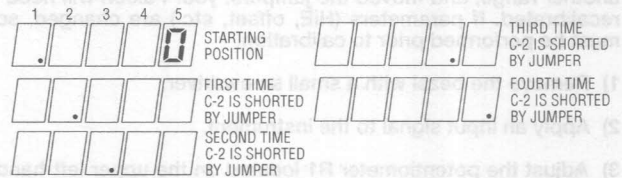
Before scaling the parameters, begin by disconnecting power to the Falcon. Place push-on jumper onto "SETUP" pins C and 2. Then apply power. At this point the Falcon performs a self test (scrolls LED display showing numerals 1 through 5) and then indicates LoE allowing you to enter the low electrical input value.

The scaling parameters for electrical low input value(LoE), electrical high input value(HiE), display low value(Lo), and display high value (Hi) are performed in the same manner as follows:

Remove push-on jumper from C-2 and then replace. Numeral zero or digit of LoE value (set at the factory) and flashing decimal point are displayed at starting LED position. The digit to be entered is always to the left of the flashing decimal point. The flashing decimal point is moved one position each time the push-on jumper is momentarily placed across "SETUP" pins C and 2. Change the value at the LED position chosen by momentarily placing jumper across "UP" pins C and 3. This will increase the value by 1 for each repetition. Repeat jumper placement until desired value is displayed. To decrease a display value, momentarily place jumper across "down" pins C and 4.

After the desired numeric value is obtained it is necessary to remove the jumper and momentarily place it across the "ENTER" pins C and 1 to store value in memory. LED display indicates next parameter. Repeat this procedure through each parameter.

After programming the last parameter (Hi) of the scaling procedure, LED will display "END" and then indicate scaled value of electrical input to the meter. The unit is now in "run" mode.



Enter-Saves digits displayed and advances to next scaling parameter when jumper makes momentary contact with pins 1 and C.

UP-Changes digit displayed to next ascending value when jumper makes momentary contact with pins 3 and C.

DOWN-Changes digit displayed to next descending value when jumper makes momentary contact with pins 4 and C.

SETUP-Starts scaling cycle of the four scaling parameters (LoE, HiE, Lo and Hi) and selects digit to be entered to the left of the flashing decimal point on display when jumper makes momentary contact with pins 2 and C.

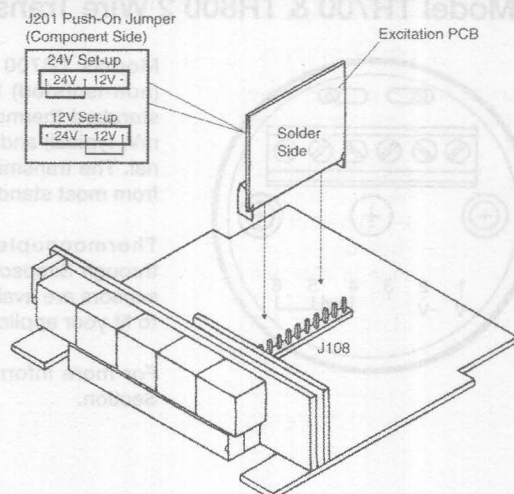
Typical Scaling Application

4-20mADC range is used

Electrical Characteristics	Falcon LED Display	
DC Process: 4-20mA	LoE: 4.000	Lo: 0
Display: 100%	HiE: 19.999	Hi: 100.00

Excitation Output

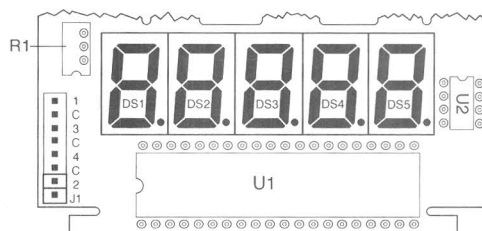
An optional feature of the Falcon is a 12 or 24 VDC output. The Falcon is set at the factory per your order to include an excitation plug-in printed circuit board. This PCB, located on the main board can be reconfigured by moving push-on jumper J201 to change the excitation output as shown in the diagram.



Calibration

The unit is calibrated at the factory per order. If you selected another range, and moved the jumpers, your Falcon will need to be recalibrated. If parameters (HiE, offset, etc.) are changed, scaling must be performed prior to calibration.

- 1) Remove the bezel with a small screwdriver.
- 2) Apply an input signal to the instrument.
- 3) Adjust the potentiometer R1 located on the upper left-hand side of the display board until display shows the full scale input.
- 4) Replace bezel carefully



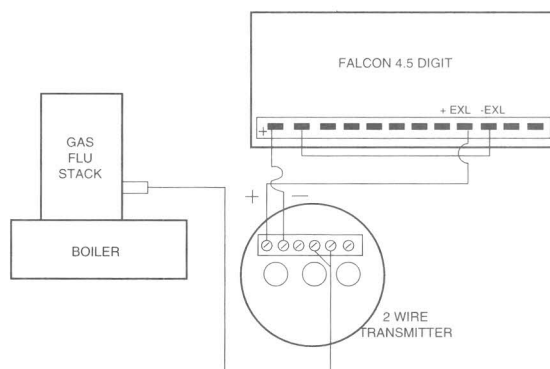
Application Example

There is a need to measure temperature of a flu gas stack of an industrial boiler. The temperature span range is 0-1500 °F.

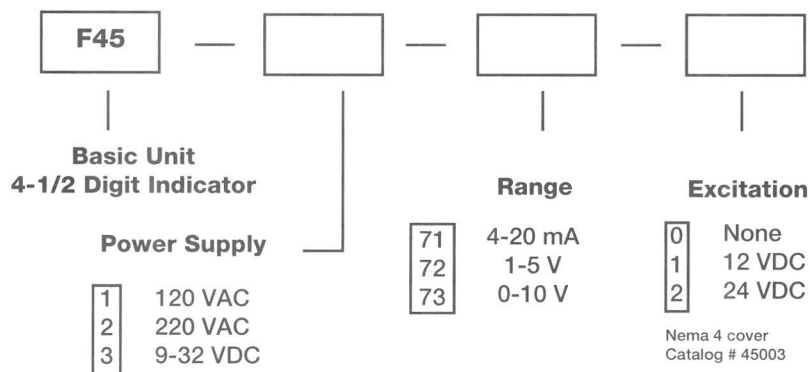
The distance for transmission back to a control panel is over 200Ft. Therefore, a Simpson TR700 transmitter is installed and mounted into an industrial protection head.

The two wire transmitter is connected to the 4-20mA Falcon. This will indicate the temperature of the flu gas stack with the proper scaling of the display to match the temperature range of the thermocouple.

To scale the display, LoE should be set at 4.000 and HiE set at 19.999. Lo should be set at 0 (°) and Hi at 1500 (°).



Ordering Information



Safety Symbols

WARNING

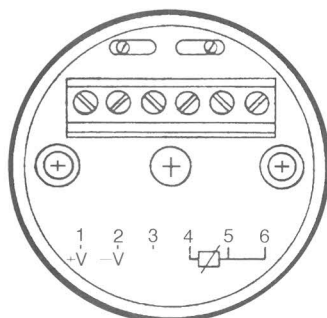
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

Model TR700 & TR800 2 Wire Transmitters

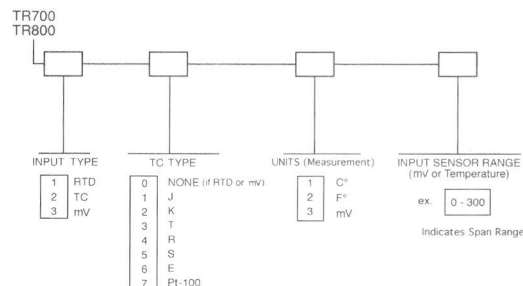


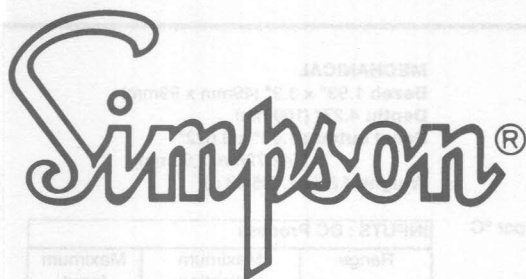
Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.

Thermocouples are also available through Simpson. J, K, T, E, and RTD sensors are available in custom lengths to fit your application.

For more information, see Accessory Section.

Transmitter Ordering Procedure

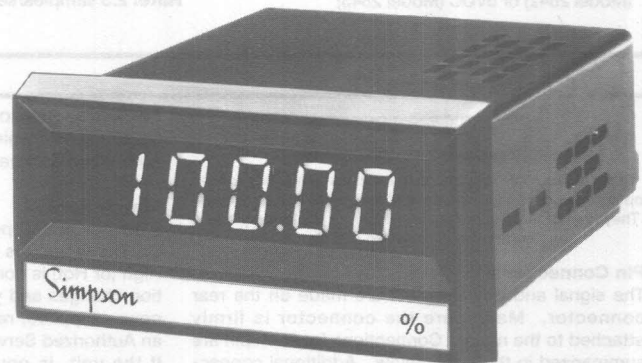




DC Process Indicators

2842 & 2843 Series 4-1/2 Digit

- 4-20 mA Process Measurement with 0-100.00% Display
- Jumper Selectable Decimal Point
- Input/Output Edge Connector
- 4-1/2 digit, 0.56" Red LED Display
- Model 2842 Requires 117 VAC Power Supply
- Model 2843 Requires 5 VDC Power Supply
- Optional 234 VAC Power Supply
- Optional Display Hold
- Additional Rear Terminal Connector Available
- Optional Cutout Adapters
- Optional "U" Shaped Mounting Bracket

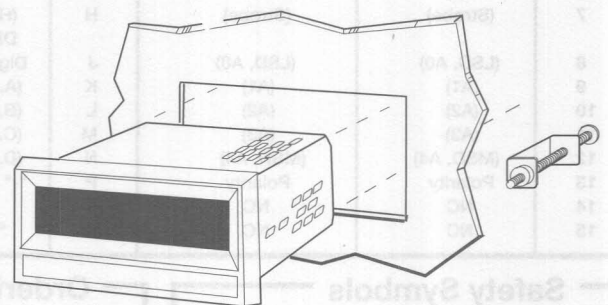
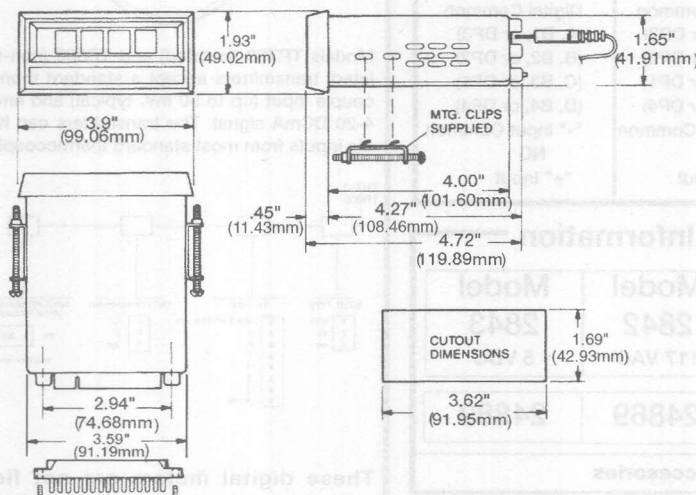


B
165

Simpson's 2842 and 2843 Series meters take in a 4-20 mA signal and display 0-100.00%. Model 2842 requires a 117 VAC input at 50-400 Hz, and Model 2843 requires a 5 VDC input at 500 mA. An optional 234 VAC power supply is available from Simpson Electric or one of our Authorized Service Centers. The large 4-1/2 digit display is easily readable from a distance (about 25 feet). Panel adapters are available for

1/8 DIN panel cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. The optional Display Hold is activated from the rear connector (when ordered). Typically a switch (not supplied) is used to activate the Display Hold so the operator may take a reading from the display.

Installation and Panel Cutout



Mounting Instructions

The 2842 and 2843 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 7 segment, red LED
Height: 0.56" (14.2mm)
Decimal point: Jumper selectable
Overrange indication: All digits blink "0",
 "1" digit off.

POWER REQUIREMENTS

AC Voltages: 117 V, $\pm 10\%$, 50 Hz to 400 Hz, 6VA
 234 V, $\pm 10\%$, 50 Hz to 400 Hz, 6 VA
DC Voltages: 5 V, $\pm 5\%$ at 500 mA
Rated Circuit to Ground Voltage: 250 VDC
 (Model 2842) or 5VDC (Model 2843)

ACCURACY @ 23°C, $\pm 2^\circ\text{C}$
 $\pm (0.05\% \text{ of input} + 1 \text{ count})$

ENVIRONMENTAL

Operating Temperature: 0 to 55°C
Storage Temperature: -40 to 60°C
Relative Humidity: 0 to 85%, non-condensing
Temp. Coefficient: $\pm(0.01\% \text{ of input} + 0.1 \text{ digit})$ per °C
Warmup time: 15 minutes

ANALOG TO DIGITAL CONVERSION

Technique: Dual Slope
Rate: 2.5 samples/second-nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)
Depth: 4.27" (109mm)
Panel cutout: 1.68" x 3.622"
 (42.72mm x 92mm)
Weight: 12.5 oz. (354.3 g)

INPUTS : DC Process

Range	Maximum Indication	Maximum Input
4-20 mA	100.00%	100 mA

B
1
6
6

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions. They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Input Signal

The "+" signal input is connected to Pin S. The "-" signal input (common) is connected to Pin P.

Display Hold

This optional feature must be specified when ordering. By shorting Pin H to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and

the display functions normally again. This optional feature is available from the factory or one of our Authorized Service Centers.

Supply Power

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.
 If the unit is powered by VDC, attach the VDC return to Pin #1 and A. The "+" VDC is connected to Pin #4.

BCD Outputs

The unit is shipped configured with BCD outputs. If Remote Decimal Point is chosen, the BCD output must be disconnected. The unit uses the same connector points for both features.

Remote Decimal Point

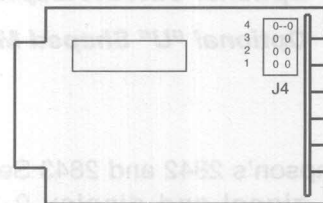
This optional feature allows you to change the decimal point without having to disassemble the meter. Please note that if you want this option, the BCD outputs and Display Hold are not available, as these options use the same terminal pins.

Pin Number	2842 Circuit	2843 Circuit	Pin Number	2842 Circuit	2843 Circuit
1	3rd wire GND	5VDC Return	A	3rd wire GND	5 VDC Return
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	(Strobe)	(Strobe)	H	(Hold/Remote DP Common)	(Hold/Remote DP Common)
8	(LSD, A0)	(LSD, A0)	J	Digital Common	Digital Common
9	(A1)	(A1)	K	(A, B1, or DP3)	(A, B1, or DP3)
10	(A2)	(A2)	L	(B, B2, or DP2)	(B, B2, or DP2)
11	(A3)	(A3)	M	(C, B3, or DP1)	(C, B3, or DP1)
12	(MSD, A4)	(MSD, A4)	N	(D, B4, or DP4)	(D, B4, or DP4)
13	Polarity	Polarity	P	"-" Input Common	"-" Input Common
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

Jumper Decimal Point

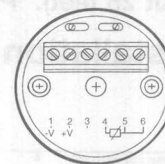
The Decimal Point can be changed by moving Jumper J4 inside the unit. The meter must be disassembled, exposing the main board. The Edge Connector should be removed first. Next, remove the two screws on the back of the bezel. Remove the front bezel, and slide out the main board.

Jumper Position	Decimal Point Position
4	1000.0
1	100.00
2	10.000
3	1.0000

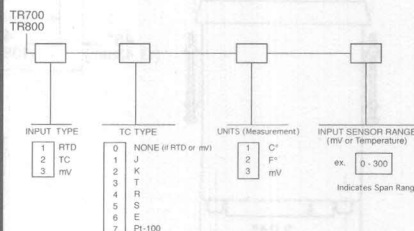


The Jumper Positions are printed on the main circuit board of the meter. After moving the jumper to the location you selected, slide the circuit board back into the meter case and re-assemble the meter.

Accessories



Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.



These digital meters are not field scaleable; please specify when ordering if you need the display scaled to a specific temperature range, or contact our factory for further assistance.

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model	Model
	2842	2843
	117 VAC	5 VDC
4-20 mA	24869	24889

Accessories

1/8 DIN Panel Adapter	22992
Domestic Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Extra Edge Connector	22990



DC Process Controllers

HAWK II Hawk II H235 Series 3-1/2 Digit On-Off Controllers

- Easily Programmed from the Front Panel
- User Friendly Software Functions Include:
Password
Display Scaling Offset
Decimal Point Selection
Zero, One, or Two Setpoints
Peak-Valley Values
Time Delay & Hysteresis
- Screw Terminal Connector for Easy Installation
- 1/8 DIN, Shallow Depth case,
3.5" (89mm) for Restricted Space Behind Panel
- Nema 4 / IP 65 Front Panel
- 2 DC Process Ranges: 4-20 mA and 1-5 VDC
- Optional 5 Amp Relay Outputs,
Excitation Outputs, and Analog Outputs

Simpson's Hawk II Microprocessor based Indicator/Controllers are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering units. Excitation outputs are available for external transmitters and transducers.

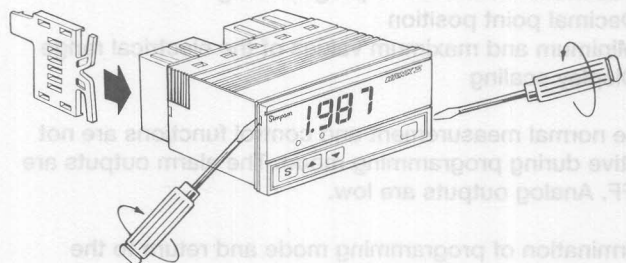
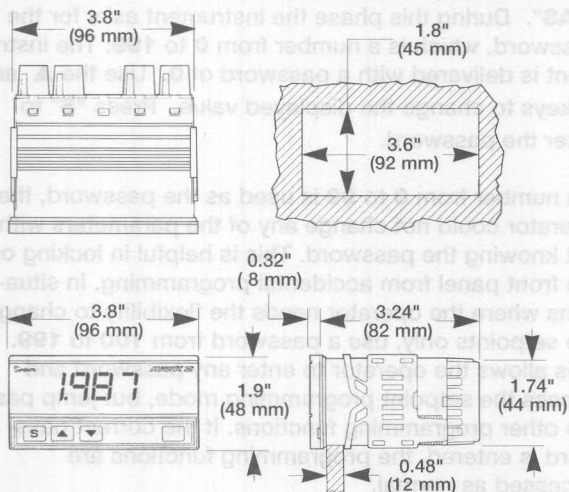
Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog outputs are also available. Other programmable software features include programmable decimal point and a password lockout feature.



Depending on the password value chosen the customer may lock out all changes, or merely those relating to setup, leaving the setpoint values accessible to the operator.

The Hawk II Series Indicator/ Controllers are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 3.56" (90mm). The Hawk II has a Nema 4 / IP 65 rated front panel which equips the unit for wash down environments. Screw terminals are standard for easy installation.

Installation and Panel Cutout



Insert the instrument into the panel and fasten it with the two brackets provided .

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 3 position software programmable from front panel.

Overrange: Display reads "EE".

Underrange: Display reads "-EE".

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 115, 230

VAC, $\pm 10\%$ **DC Voltages:** Future

Availability

Power Consumption: 6 VA

ACCURACY:

0.2% $\pm$ 2 digits

ENVIRONMENTAL

Operating Temperature: 0°C to +50 °C

Storage Temperature: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 23°C

Temperature Coefficient (per °C):

± 100 ppm/°C

± 0.05 dgt/°C

Warmup Time: 10 minutes

NOISE REJECTION

NMRR: 50 dB, GR = 50 Ω

CMRR: 100 dB, GR = 1 K Ω

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: Approximately 2 display updates per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .32" (96mm x 48mm x 8.1mm)

Depth: 3.56" (90mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm) 1/8 DIN

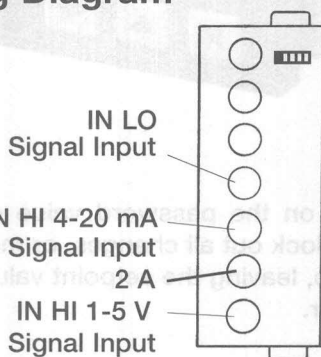
Case Material: ABS/Polycarbonate blend

Weight: 10.5 oz. (297.7 g)

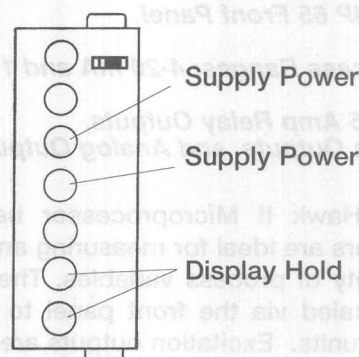
Inputs: DC Process

Input Range	Display Resolution	Voltage Drop	Max. Overload (10 Sec.)
4-20 mA	10 μ A	0.2 V (Input Impedance)	200 mA (1 Min.)
1-5 V	10 mV	1 M Ω	690 V

Wiring Diagram



Input Signal: connect the signal to be monitored to the IN HI and the IN LO terminals. Note that the IN HI signal has two terminals that can be used, depending on the process being monitored. The upper IN HI terminal accepts 4-20 mA inputs. The lower IN HI terminal accepts 1-5 VDC.



Supply Power: Connect the power to the input power terminals. **Display Hold:** Short the terminals marked HOLD to activate. The comparison of the input variable with the alarm setpoint remains active. To re-activate this display, disconnect the short circuit.

Programming

The Programming mode allows the user to define the instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling

The normal measurement and control functions are not active during programming mode. The alarm outputs are OFF. Analog outputs are low.

Termination of programming mode and return to the measurement and control mode is automatic at the end of all the programming steps or after 3 minutes with no key activation. Display will briefly show "End"

Access to programming

Press the "S" key and the $\blacktriangle$. The display should show "PAS". During this phase the instrument asks for the password, which is a number from 0 to 199. The instrument is delivered with a password of 0. Use the $\blacktriangle$ and $\blacktriangledown$ keys to change the displayed value. Press "S" to enter the password.

If a number from 0 to 99 is used as the password, the operator could not change any of the parameters without knowing the password. This is helpful in locking out the front panel from accidental programming. In situations where the operator needs the flexibility to change the setpoints only, use a password from 100 to 199. This allows the operator to enter any password and access the setpoint programming mode, but jump past the other programming functions. If the correct password is entered, the programming functions are accessed as normal.

Programming cont.

Forgot your password?

If the password is forgotten, it can be reset to 0. The unit must be powered down. Hold down the "S" key and the ▼ key at the same time, and power up the unit. Release the keys when the display shows **PAS** for about two seconds. Press the ▲ key so the display reads **99**. Press the "S" key to enter this value, and the reset is done automatically. The mode is terminated, and the system is restarted.

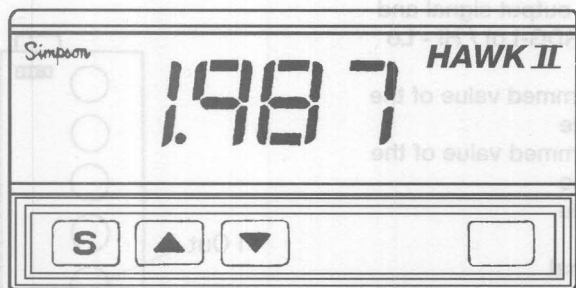
Programming a new password

To retain the present value for the password, press the "S" key to pass to the next parameter.

To modify the password, press the ▲ and ▼ keys to affect the value. Remember that the value must be a number from 0 to 199. Press "S" to move to the next parameter.

Decimal Point Selection

The display will show "dP" for about 2 seconds. The display will then show the current position of the decimal point on the display by a steady light (see the following figure). Change the position with the ▲ and ▼ keys. Press "S" to move to the next parameter.



Programming the electrical input range (HiE and LOE)

This feature allows you to define the electrical input range. It also allows you to define a range different from the standard one.

The display will show **HiE**, signifying the maximum electrical input range. The value stored in memory is displayed. To retain the present value, press the "S" key. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The Display will show **LOE** for about 2 seconds, signifying the minimum electrical input range. The display will then show the value stored in memory. Use the ▲ and ▼ keys to change the displayed value. Press the "S" key when the correct value is displayed.

The **HiE** and **LOE** values are shown in the same engineering units as the input range.

Display Scaling

This allows you to define the display span (in engineering units) corresponding to the previously defined electrical input range. For example:

Programmed elec. input range: 0 to +19.99 (LOE to HiE)

Programmed display span: 0 to 100% (LO to Hi)

LO = displayed value corresponding to the minimum of input range (**LOE**).

Hi = displayed value corresponding to the maximum of input range (**HiE**).

The link between the electrical and the displayed value is completely adjustable/variable, thus it is possible to correlate a minimum electrical value to a maximum display value, and vice versa (scale inversion).

For best resolution, see formula at bottom of page.

The display will show "**Hi**" for about 2 seconds. Then the display will indicate the **Hi** value stored in memory.

Use the ▲ and ▼ keys to change the displayed value. The maximum is **+1999**. Press the "S" key when the correct value is displayed.

The display will show "**LO**" signifying the minimum of the display span. The display shows the value stored in memory. To modify the value, use the ▲ and ▼ keys. The value can be as low as **-1999** in the DC Process meter. Press the "S" key to pass to the next parameter.

The programming sequence will end here and revert to normal operation unless there are relays built into the unit. If so, the meter will display SP1. This information is in the **Programming the Relays** section.

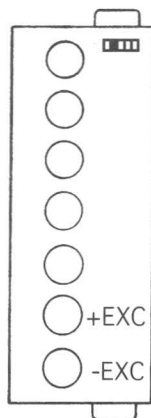
$$\left| \frac{\text{HiE} - \text{LOE}}{\text{Hi} - \text{LO}} \right| \pm 1$$

Excitation Output

Optional 12 or 24 VDC Excitation power supply is available on the Hawk II. This Excitation power can be used to energize many common types of transducers and transmitters. By using the Excitation power from the Hawk II you do not have to set up an external power source for transmitters or transducers.

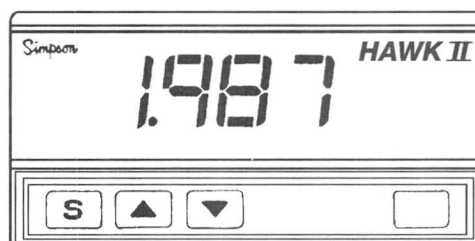
The source is isolated from the measurement input as well as the input power circuits. The connections are made to the +EXC and the -EXC terminals on the rear of the meter. Maximum Current load is 20 mA for either 12 or 24 VDC.

Note: Excitation power is not available in conjunction with analog output.



Peak-Valley

By pressing both the ▲ and the ▼ keys at the same time, the highest and lowest values are displayed. These are referred to as the Peak and Valley values. The Hawk II displays the Peak first, then the Valley, then returns to the normal operation. To reset the values in memory, press all three buttons at the same time.



Analog Output

All Analog output signals are linearly proportional to the displayed values.

CAUTION

Isolation voltage of 125 Vrms between analog output and the rest of the Hawk II system limits the use of the system, and is only intended to break ground loops, not as a safety isolation.

4-20 DC mA Output signal:

Relationship between the output signal and displayed value: $I = \frac{16}{Hi-Lo} (RDG-Lo) + 4$

I = Output current (mA)

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

0-1 VDC Output signal

Relationship between output signal and displayed value: $V = (RDG-Lo) / Hi - Lo$
V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value

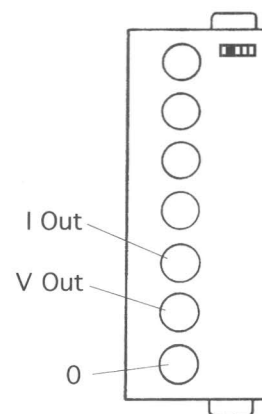
0-10 VDC Output signal

Relationship between output signal and displayed value: $V = 10(RDG-Lo) / Hi - Lo$
V = Output Voltage

Hi = Maximum programmed value of the whole measuring range

Lo = Minimum programmed value of the whole measuring range

RDG = Displayed Value



Relationship between over/underrange situations and Analog outputs:

Input signal to Hawk II	Display Indication	Output 4-20mA	Output 0-1 V	Output 0-10 V
Overrange	EE	20 mA	1 V	10 V
Underrange	- EE	4 mA	0 V	0 V

NOTE:

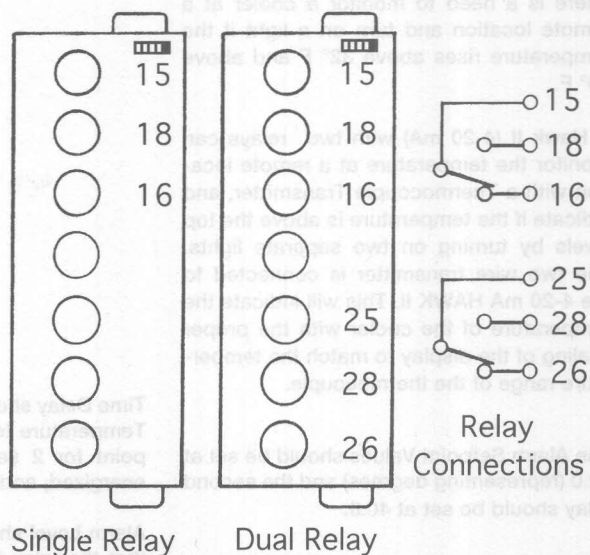
Analog output is not available in conjunction with Excitation

Output Range	Accuracy	Temperature Drift	Max. Load Resistance	Output Resistance	Short-Circuit Protection
4-20 mA	±1% ±0.1 mA	±200 ppm/ C	500 Ohm	N/A	Yes
0-1 V	±1% ±0.005V	±200 ppm/ C	N/A	≤3 Ohm	Yes
0-10 V	±1% ±0.05V	±200 ppm/ C	N/A	≤3 Ohm	Yes

Relays

Optional relays are available with the Hawk II. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk II to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk II to eliminate "chatter" in the relays. The Hawk II has a Time Delay adjustment of 0 to 99 seconds for the set points.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk II is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk II can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.



Programming the Relays

The Hawk II automatically senses if a relay card is present in the instrument. Programming continues after you have set the **HI** parameter. When relays are present you must program the following values (in this order):

- Setpoint Values
- Hysteresis
- Time Delay
- High or Low Alarm Levels
- Relay Status
- Overrange Status

The programming for Setpoint Value (**SP1**), Hysteresis (**HYS**), Time Delay (**dEL**), High (**uP**) or Low (**do**) Alarm levels, Relay Status (**nE** and **nd**) and Overrange Status (**On/OFF**) are performed in the same manner:

1. The display will show **SP1** (or other programming variable), and then display the stored setpoint value.
2. To retain the present value, press the "**S**" key to pass to the next parameter.
3. To select a new value, press the **▲** or **▼** to increase or decrease the displayed value.
4. Press "**S**" when you have reached your desired value to pass to the next parameter.

Setpoint Values: The setpoint is relative to the display span and not to the electrical input range. Please remember that you can program a password to enable only the setpoints to be changed. This allows the operator flexibility in using the Hawk II, without the potential for erroneous programming of other parameters. If an incorrect password is entered, the program jumps to the **SP1** mode. If the correct password is entered (100-199), the operator can change the parameters.

Hysteresis: Hysteresis is the difference between the programmed setpoint value (value at which the alarm is set ON) and the value at which the alarm is disabled. If a reading is flipping between two points that are above and below the setpoint, this can cause the relay to "chatter" on and off rapidly. Hysteresis helps eliminate "chatter" in the relays. The value is selected from 1 to 1999.

Time Delay: The Time Delay is programmable from 0 to 99 seconds. Time Delay is similar to Hysteresis, but instead allows the input to exceed the setpoint for a specific amount of time before triggering the relay. For example, 2 would delay the relay from energizing for 2 seconds after exceeding the setpoint. The Time Delay is reset when the input falls below the Setpoint.

High and Low Alarm Levels: You must choose if the relay is to be triggered when the input exceeds (for High Alarm = **uP**) or falls below (Low Alarm = **do**) the Setpoint.

Relay Status: This parameter determines the state of the relay in the absence of an alarm; Normally Energized, or Normally De-Energized.

Overrange Status: This allows the user to choose if the relay is on or off in an overflow/underflow condition.

At this point, if a second relay is also installed in the unit, **SP2** will be displayed, and this procedure repeated for the second relay. After all parameters have been programmed, the programming mode is terminated automatically, and the system restarts. In normal operation, the setpoints can be displayed by pressing the **▲** key to show **SP1**, or the **▼** key to show **SP2**.

Application Example

There is a need to monitor a cooler at a remote location and turn on a light if the temperature rises above 32° F and above 40° F.

A Hawk II (4-20 mA) with two relays can monitor the temperature at a remote location with a Thermocouple Transmitter, and indicate if the temperature is above the top levels by turning on two separate lights. The two wire transmitter is connected to the 4-20 mA HAWK II. This will indicate the temperature of the cooler with the proper scaling of the display to match the temperature range of the thermocouple.

The Alarm Setpoint Values should be set at 32.0 (representing degrees) and the second relay should be set at 40.0.

HiE should be set at 19.99, and LOE set at 4.00. Hi should be set at 100.0, and LO set at 0.

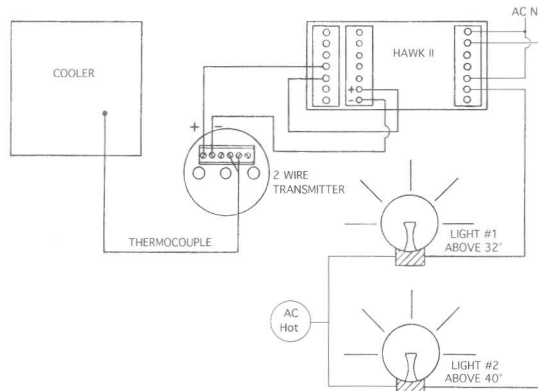
Time Delay should be set at 2, allowing the Temperature to rise above the Alarm Setpoint for 2 seconds before the relay is energized, and turns on the light.

Alarm Level should be set for up ("uP") so that the relay is energized when the temperature rises above each Alarm Setpoint. The first will light up above 32°, and the

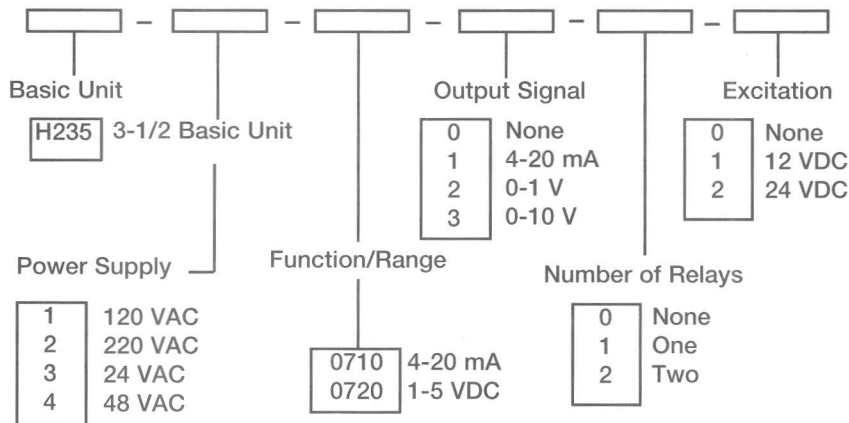
second will light up above 40°.

Relay Status is normally de-energized (nd), representing the relay status in the absence of an alarm situation.

The Hawk will now display the temperature (0-100 degrees).



Ordering Information



Safety Symbols

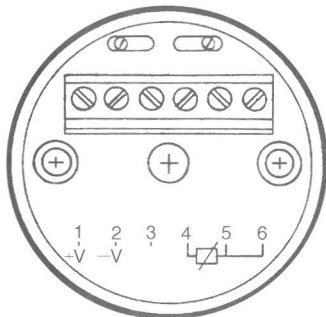
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

Accessories

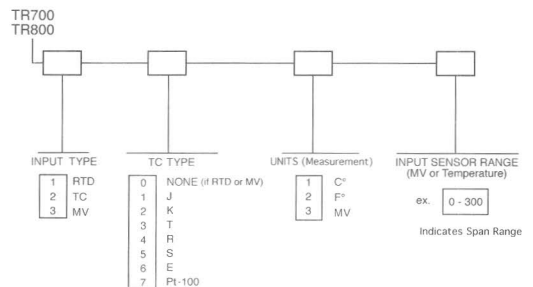


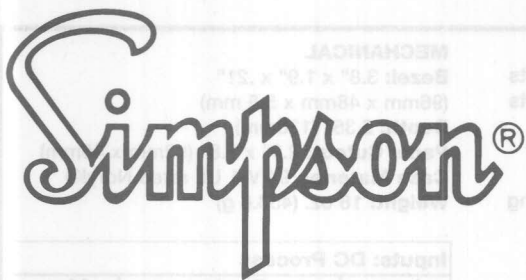
Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.

Thermocouples are also available through Simpson. J, K, T, E, and RTD sensors are available in custom lengths to fit your application.

For more information see Accessory Section.

Transmitter Ordering Procedure (TR700 & TR800)





DC Process Controllers

Hawk HK35 & HK45 Series 3-1/2 & 4-1/2 Digit

B
1
7
3

■ Easily Programmed From the Front Panel

■ Software Functions Include:

Password	Display Scaling & Offset
One or Two Set Points	Decimal Point Selection
Time Delay & Hysteresis	

■ 3-1/2 or 4-1/2 Digit, Bright Red Display, 0.56" (14.2 mm) High

■ 2 Piece Screw Terminal Connector

■ Display Hold

■ 1/8 DIN Case, Made of High Impact Noryl®

■ 2 DC Process Ranges: 4-20 mA, 1-5 VDC

■ Optional Nema 4 Front Panel Cover

■ Optional 5 Amp Relays and Analog/Digital Outputs

Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit. Optional Peak Hold is available to replace the standard Display Hold, allowing the operator to observe peak values in the input signal.

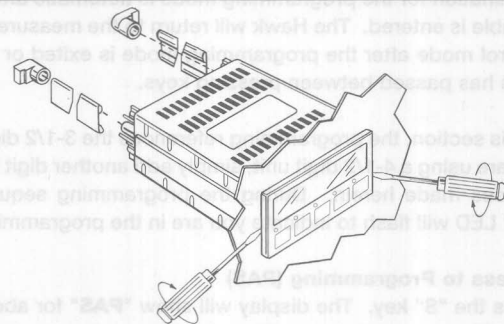
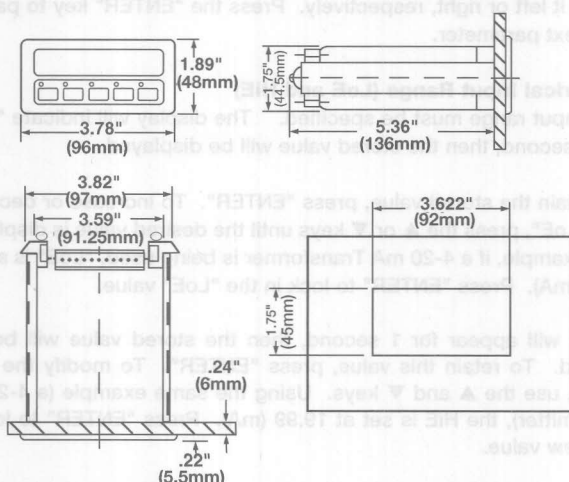
Two optional 5 Amp Relays include front panel programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include



programmable decimal point and a password lockout feature. By using the password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl®. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the mounting brackets, side retainers, and screws.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 4 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 120, 240 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA

ACCURACY @ 25° C

HK35: 0.10% of input ± 1 digit

HK45: 0.05% of input ± 1 digit

Peak Hold HK35: 1.0% of input ± 40 digits

Peak Hold HK45: 0.5% of input ± 40 digits

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):

± 100 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 70 dB (1 K Ω unbalanced) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate:

HK 35: 4 times per second

HK 45: 2 times per second

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

Case Material: 94 V-1 UL rated Noryl®

Weight: 16 oz. (453.6 g)

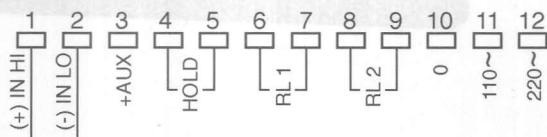
Inputs: DC Process

Input Range	Display Resolution		Max. Overload
	HK 35	HK 45	
4-20 mA [^]	10 μ A	1 μ A	40 mA
1-5 V [*]	10 mV	1 mV	100 V

[^]Input Impedance = 1 M Ω

^{*}Voltage drop = 250 mV

Wiring Diagram



Input Signal:

Connect the input signal to the IN HI and the IN LO terminals (#1 and #2).

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2"

LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change the position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. For example, if a 4-20 mA Transmitter is being used, "LoE" is set for 4.00 (mA). Press "ENTER" to lock in the "LoE" value.

"HiE" will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the $\blacktriangle$ and $\blacktriangledown$ keys. Using the same example (a 4-20 mA transmitter), the HiE is set at 19.99 (mA). Press "ENTER" to lock in the new value.

Programming cont.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values from transducers to transmitters. For example:

Electrical Input Range : 4-20 mA (LoE to HiE)

Programmed Display Scaling: 0 to 100.0% (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. The example calls for a Low of 0.0 (%). Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. In our example, the Hi is 100.0(%). Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-energized ("nd"). Press "ENTER" to store desired setting in memory.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

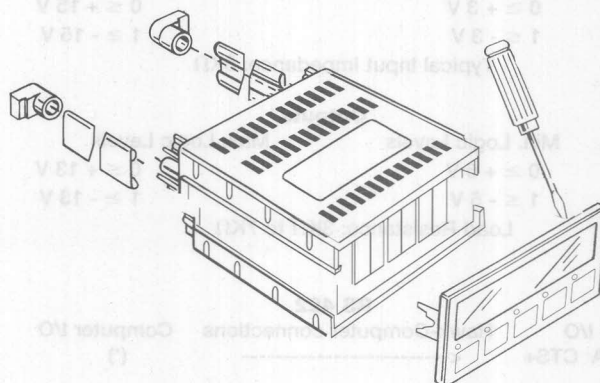
Exiting Programming Mode

After programming the relay(s), press the "S" key to exit the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts inside or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case. Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.

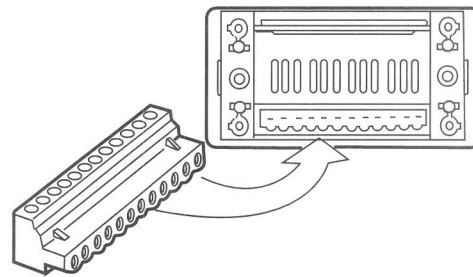


2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Additional connectors are available at your Authorized Hawk Distributor.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3\text{ V}$	$0 \leq +15\text{ V}$
$1 \leq -3\text{ V}$	$1 \geq -15\text{ V}$

Typical Input Impedance: $5\text{ K}\Omega$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5\text{ V}$	$0 \leq +13\text{ V}$
$1 \leq -5\text{ V}$	$1 \geq -13\text{ V}$

Load Resistance: $3\text{ K}\Omega$ to $7\text{ K}\Omega$

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

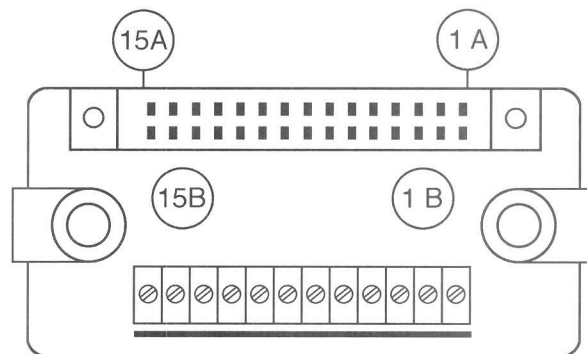
Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2\text{ V (diff)}$	$0 \leq +12\text{ V (diff)}$
$1 \leq -0.2\text{ V (diff)}$	$1 \geq -12\text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5\text{ V (diff)}$	$0 \leq +5\text{ V (diff)}$
$1 \leq -1.5\text{ V (diff)}$	$1 \geq -5\text{ V (diff)}$

Termination Resistances : $100\ \Omega \pm 10\%$



(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.

CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

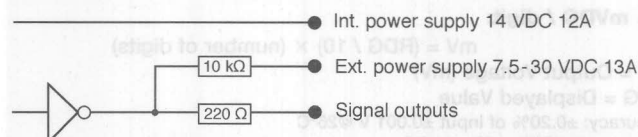
BCD Outputs

There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Function	Pin	Auxiliary Signals
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Internal Power supply V+	12 A	



Ext. Open Coll. Pow. Supply 13 A

IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs									
1st digit(lsd)		2nd digit		3rd digit		4th digit		5th digit(msd)	
Value	Pin	Value	Pin	Value	Pin	Value	Pin	Value	Pin
1	1B	10	1A	100	5B	1,000	9B	*10,000	5A
2	2B	20	2A	200	6B	*2,000	10B		
4	3B	40	3A	400	7B	*4,000	11B		
8	4B	80	4A	800	8B	*8,000	12B		

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Function	Pin	Auxiliary Signals
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The Enable commands (active low) allow you to select the group of data outputs indicated in the table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mA DC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for process controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mA DC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminal connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mA DC:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C (HK 35)

Temperature Drift: ± 120 ppm/°C (HK 40 and HK 45 RTD/TC)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

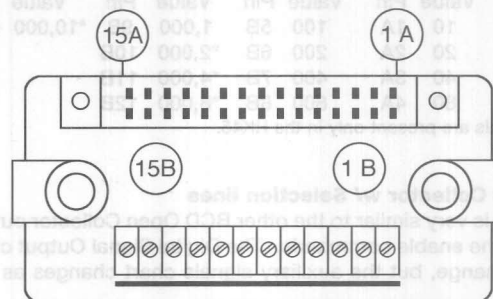
Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit

Output Resistance $\leq 3\Omega$

The signal outputs are protected from short circuits.

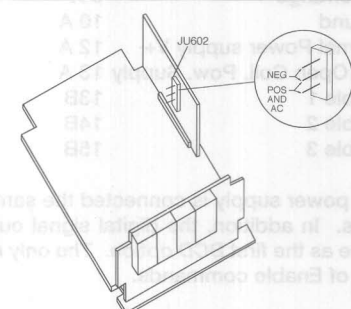
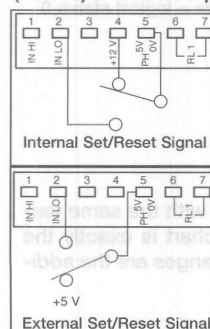


Peak Hold

The Peak Hold feature is used to display DC values, such as positive or negative Voltage or Current peaks. This feature can be controlled internally or externally. The display will briefly "Hold" the peak value, and slowly "decay" to the current input signal. The decay rate is approximately 1 digit per second for the 3-1/2 digit unit, and approximately 5 digits per second for the 4-1/2 digit unit. Display Hold is not available for use when Peak Hold is ordered with the Hawk because the two features use the same terminal contacts.

To measure peak values, apply zero volts DC to the Peak Hold input (terminal #5) by connecting terminal #5 to terminal #2. To clear the reading using the internal source, apply a minimum of 5 VDC through a maximum of 12 VDC to terminal #5. This can be accomplished by connecting terminal #4 to #5. To clear the reading using an external source, connect terminal #5 to an external reference.

The controller can be used to capture Negative Voltage/Current Peaks. Disassemble the unit and move the programmable jumper (JU602) to the next position as illustrated in the lower right diagram.



Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels correspond to the setpoint values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart below shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,

4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

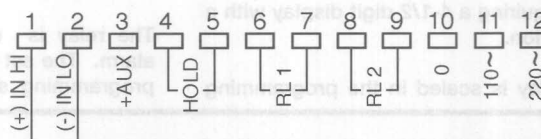
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals #6 and #7, and relay #2 is wired from terminals #8 and #9.



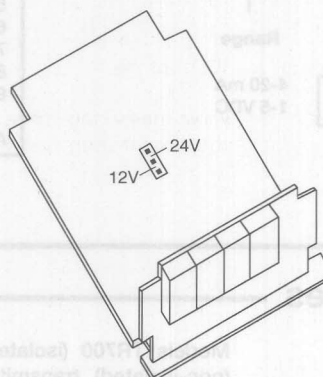
Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

Excitation Output

Excitation output is an optional feature for the Hawk Controller. 12 or 24 VDC excitation is available, preset to your specifications. The value can be changed in the field by moving the jumper on the main board (see diagram).

The Excitation output eliminates the need to set up expensive DC power supplies for external transmitters and transducers that can be used with the Hawk. The 12 Volt output supplies 30 mA maximum, and the 24 Volt output supplies 25 mA maximum.

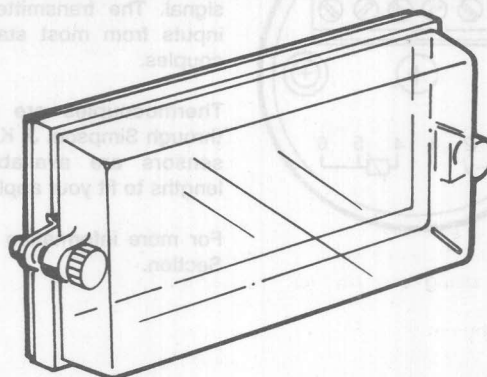
Please specify when ordering which value you need. The controller can be retrofitted with Excitation through the Factory or one of our Authorized Service Centers.



NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



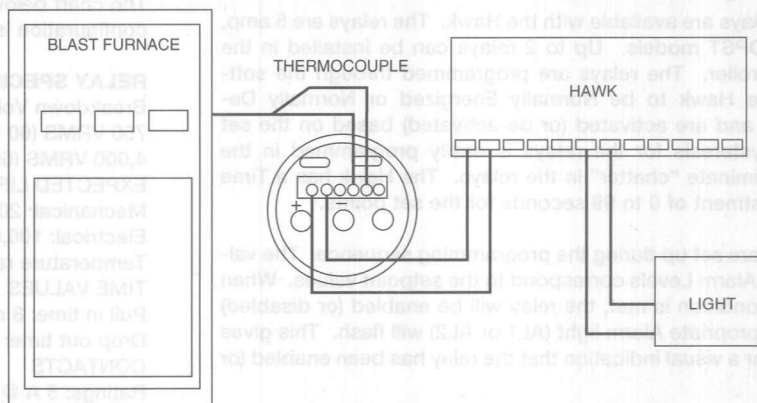
Application Example

There is a need to remotely monitor the temperature of a blast furnace in a steel tempering facility. A siren needs to sound if the temperature drops below 2200°, and the controller needs a password lockout so the set points are not accidentally changed.

A 4-1/2 digit Hawk Process controller with a temperature transmitter fits the application requirements. A Type K thermocouple is used, and attached to the transmitter. The transmitter is located in a thermal head near the thermocouple site. The transmitter takes in the mV signal from the thermocouple and emits a 4-20 mA signal to the Hawk. The 4-20 mA signal is superior to the mV signal for transmission over long distances. The 4-20 mA signal is run to the Hawk located in a control room.

A 4-1/2 digit Hawk is required because the temperature being monitored ranges up to 2200°, requiring a 4-1/2 digit display with a 1° resolution.

The display is scaled in the programming



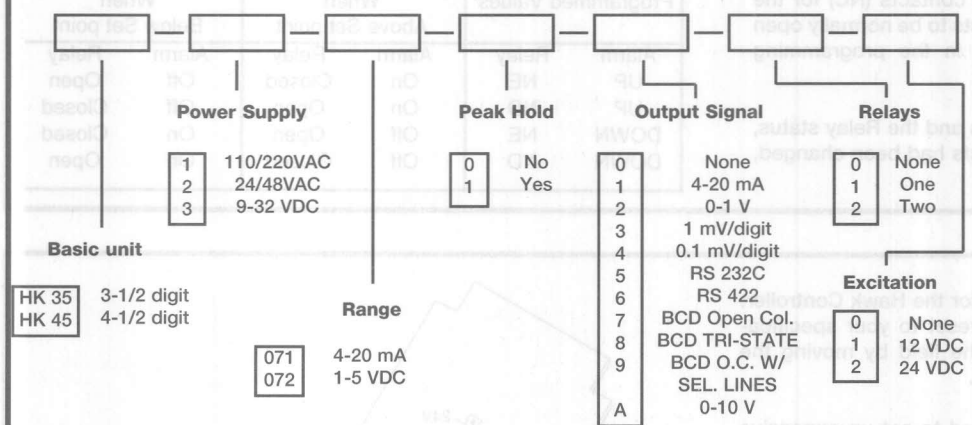
mode. The HiE is set at 19.999 mA, and the LoE is set at 4.000 mA. This is the signal coming from the transmitter. The Hi is set at 2282°F, and the Lo is set at 32°F. These are the high and low values of a Type K thermocouple.

The relay is connected to the siren or alarm. The set point are designated in the programming sequence. "SP" is set at

1800(°F), and the Alarm Level is set at down. This will activate the alarm if the temperature falls below 1800°F. Hysteresis is set at 1, and Time Delay is set for 0 seconds. The Relay Status is set for Normally Energized. This will activate when an alarm condition occurs.

The Hawk is now set to monitor the temperature in the furnace.

Ordering Information



NEMA 4 Cover : Catalog # 45003

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Accessories

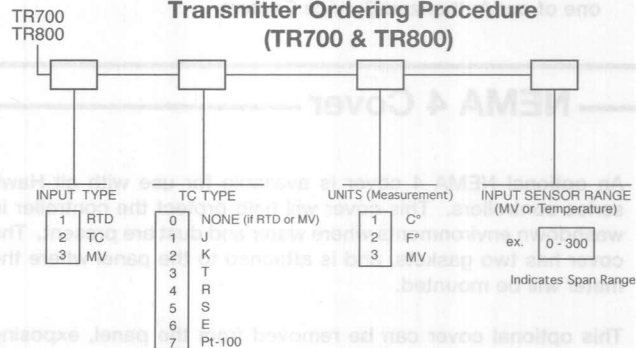


Models TR700 (isolated) and TR800 (non-isolated) transmitters accept a standard thermocouple input (up to 50 mV, typical) and emit a 4-20 DCmA signal. The transmitters can handle inputs from most standard thermocouples.

Thermocouples are also available through Simpson. J, K, T, E, and RTD sensors are available in custom lengths to fit your application.

For more information see Accessory Section.

Transmitter Ordering Procedure (TR700 & TR800)





Resistance Controllers

Hawk HK35 & HK45 Series Resistance & 3-wire potentiometer 3-1/2 & 4-1/2 Digit

- Easily Programmed From the Front Panel
- Software Functions Include:

Password	Display Scaling
One, or Two Setpoints	Decimal Point Selection
Time Delay & Hysteresis	
- Display Hold
- 2 Piece Screw Terminal Connector for Easy Installation
- 3-1/2 or 4-1/2 Digit, 0.56" (14.2 mm) High Display
- 1/8 DIN Case Made of High Impact Noryl®
- 4 Resistance Ranges: 200 Ω , 2 K Ω , 20 K Ω , 200 K Ω
- 2 Potentiometer Ranges: $\pm 1999\Omega$, $\pm 19999\Omega$
- Optional Nema 4 Front Panel Cover
- Optional 5 Amp Relays and Analog/Digital Outputs

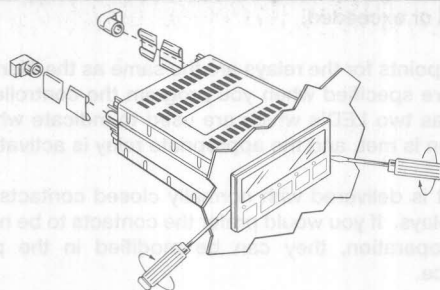
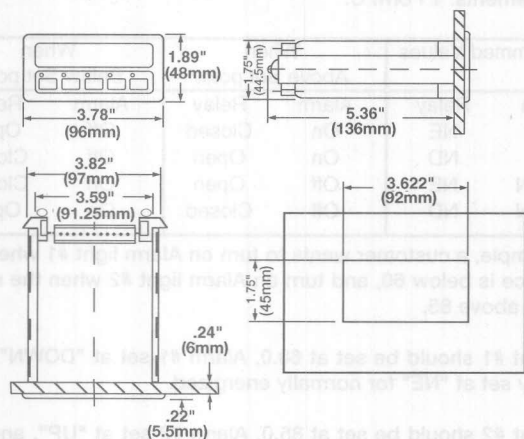
Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include programmable decimal point and a password lockout feature. By using the

Password feature, the meter's programming functions and set points are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case with a depth of only 5.35" (136mm). The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A 2 piece screw terminal is standard for easy installation and removal of the controller.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2 mm).

Decimal Point: 4 position software programmable from the front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators for alarm conditions on front panel

Input Impedance: > 50 K Ω (3-wire only)

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA max.

ACCURACY:

HK35: 0.10% of input ± 1 digit

HK 45: 0.05% of input ± 1 digit

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temp Coefficient (per °C): ± 100 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 90 dB (1 K Ω unbalanced) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate:

HK 35: 4 samples per second, nominal

HK 45: 2 samples per second, nominal

Open Circuit Voltage: 2.5 V, except 200 Ω is 250 mV

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

Material: 94 V-1 UL rated Noryl®

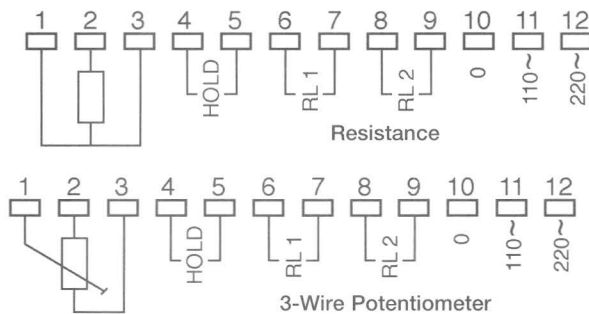
Inputs: Resistance

Input Range	Display Resolution		Max. Excitation	Open Circuit Voltage
	HK 35	HK 45		
200 Ω	0.1 Ω	0.01 Ω	1.25 mA	250 mV
2 K Ω	1 Ω	0.1 Ω	125 μ A	2.5 V
20 K Ω	10 Ω	1 Ω	12.5 μ A	2.5 V
200 K Ω	100 Ω	10 Ω	1.25 μ A	2.5 V

3-Wire Potentiometer

1 ± 50 Ω	$\pm 1,999$	$\pm 19,999$	---	5 V
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Wiring Diagram



Input Signal:

Connect the input signal to terminals #1, #2 and #3 as shown in the diagram.

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active, allowing the meter to function normally when the display is held. To re-activate the display, remove the short between the two terminals.

Relays

Up to two relays are available for the Hawk controller. The relays are 5 amp, 250 VAC, DPST models. The functions of the relays are defined in the programming mode. The functions include the set point, the alarm level, hysteresis, time delay, and status of each relay.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without soldering or unsoldering them.

The bottom chart shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,

4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on Alarm light #1 when the resistance is below 60, and turn on Alarm light #2 when the resistance is above 85.

Set point #1 should be set at 60.0, Alarm #1 set at "DOWN", and the relay set at "NE" for normally energized.

Set point #2 should be set at 85.0, Alarm #2 set at "UP", and the relay set at "NE" for normally energized.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. The input variable is not monitored during the programming sequence. The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The ▲ and ▼ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2" LEDs will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the ▲ or ▼ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" (or "11111" if a 4-1/2 digit display) and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the ▲ or ▼ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the ▲ or ▼ keys until the desired value is displayed. Press "ENTER" to lock in the "LoE" value.

"HiE" will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". To modify the "HiE" value, use the ▲ and ▼ keys. Press "Enter" to lock in the new value.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit.

For example:

Electrical Input Range : 0 to 19.99 KV (LoE to HiE)

Programmed Display Scaling: 0 to 75 Feet (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease

the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▼ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the value. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which we want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ makes the status Normally Energized ("nE"), while the ▼ key makes the status Normally De-energized ("nd"). Press "ENTER" to store desired setting in memory.

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

Exiting Programming mode

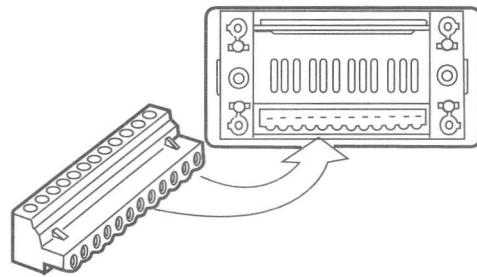
After programming the relay(s), the Hawk automatically exits the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

Then the screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C		
Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3 \text{ V}$	$0 \leq +15 \text{ V}$
$1 \leq -3 \text{ V}$	$1 \geq -15 \text{ V}$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5 \text{ V}$	$0 \leq +13 \text{ V}$
$1 \leq -5 \text{ V}$	$1 \geq -13 \text{ V}$

Load Resistance: 3K Ω to 7K Ω

RS 422		
Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

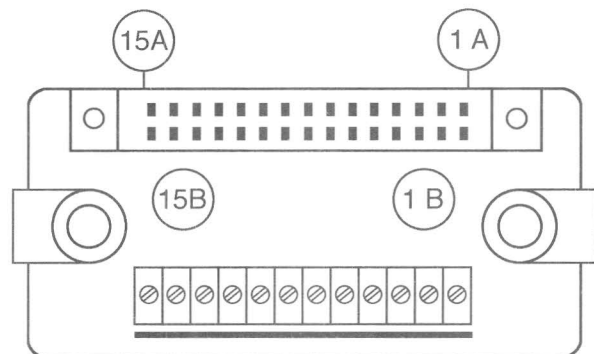
Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2 \text{ V (diff)}$	$0 \leq +12 \text{ V (diff)}$
$1 \leq -0.2 \text{ V (diff)}$	$1 \geq -12 \text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5 \text{ V (diff)}$	$0 \leq +5 \text{ V (diff)}$
$1 \leq -1.5 \text{ V (diff)}$	$1 \geq -5 \text{ V (diff)}$

Termination Resistances : 100 Ω $\pm$ 10%



(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.

CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

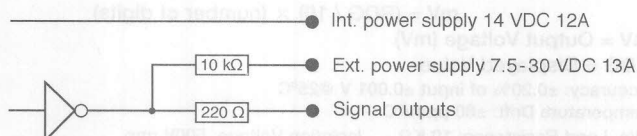
BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by placing a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A

(*) Negative = logical status 1
Positive = logical status 0



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(lsd)	2nd digit	3rd digit	4th digit	5th digit(msd)
Value Pin	Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B	*10,000 5A
2 2B	20 2A	200 6B	*2,000 10B	
4 3B	40 3A	400 7B	*4,000 11B	
8 4B	80 4A	800 8B	*8,000 12B	

* These signals are present only in the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 19 (for HK35) or 23 (for HK45) to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign (and the 5th digit if you are using a HK45). Each data group can be selected by means of 3 Enable lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A
Underrange	9 A
Ground	10 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

(*) Negative = logical status 1
Positive = logical status 0

The Enable commands (active low) allow you to select the group of data outputs indicated in the table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mA
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for Resistance/3-wire Potentiometer controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mA	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminal connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mA:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C (HK 35)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

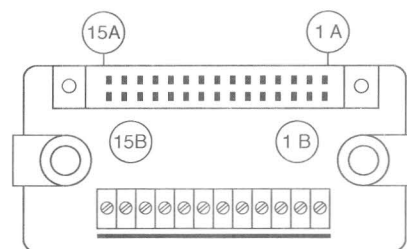
Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit Output Resistance $\leq 3\Omega$

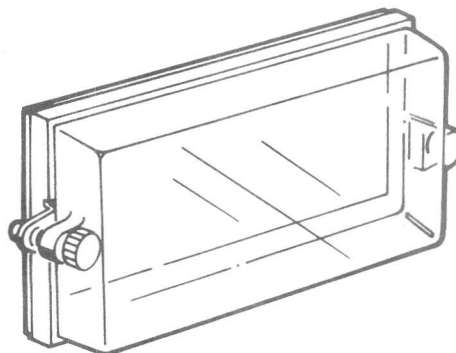
The signal outputs are protected from short circuits.



NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.



Application Example

A specification calls for a meter that will display from 0 to 100% for a displacement application. The signal input to the meter is coming from a 3-wire potentiometer, and the system has a resistance of 10 K Ω . In addition, a single relay is needed to turn on a pump if the displacement exceeds 90%, and the meter must send a 0.1 mV/digit analog output signal to a strip chart recorder (for a maintenance / production log).

A Hawk 3-wire potentiometer controller with a 0.1 mV/digit analog output signal can fill the application need. The 4-1/2 digit display will offer excellent resolution for the application, and the 0.1 mV/digit is only available in the 4-1/2 digit version.

The display will need to be scaled. The scaling will be handled through the programming function.

NOTE: Make sure that LoE, Lo and HiE, Hi parameters are between 0 and 1999 (HK35), or to 19999 (HK35).

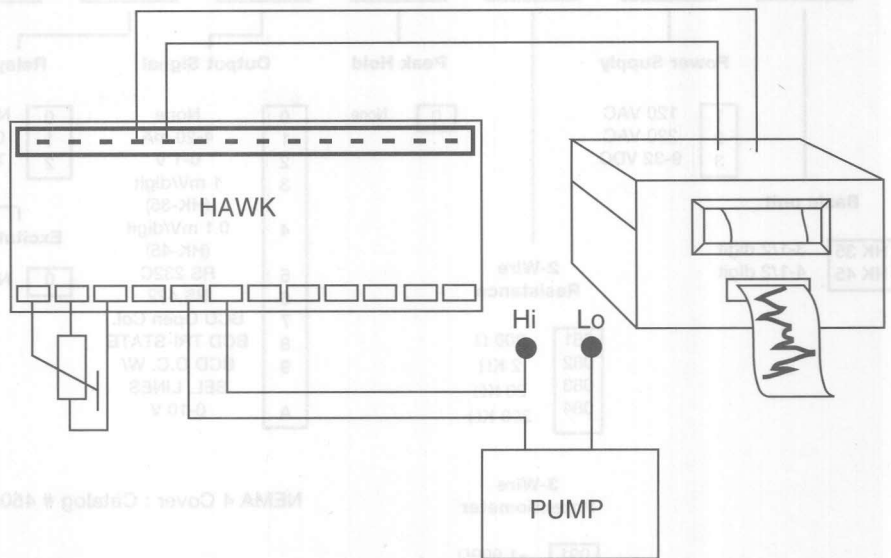
Set the instrument to the measuring mode and proceed as follows:

- Set the potentiometer to the desired minimum operating value and read the measurement on the display.
- Set the potentiometer to the desired maximum operating value and read the measurement on the display.

Set the instrument to the programming mode and enter the above-noted values "a" and "b" respectively as LoE and HiE.

Set the desired Lo and Hi values (Lo = min. displayed input value, Hi = max. displayed input value).

By setting the potentiometer to the minimum operating value, the displayed value



will be approx. 400 (HK35), and 4000 (HK45) corresponding to 20% of F.S.

By setting the potentiometer to the maximum operating value, the displayed value will be approx. 1600 (HK35), and 16000 (HK45), corresponding to 80% of F.S.

Measuring potentiometer:	10 KV (100% of electrical stroke)
Minimum operating value:	2 KV (20% of electrical stroke)
Maximum operating value:	8 KV (80% of electrical stroke)
Start of displayed range:	00.0% (HK35)/00.00% (HK45)
End of displayed range:	100.0% (HK35)/100% (HK45)

The relay setpoint is programmed through the front panel buttons. The setpoint is 90.00(%). The Alarm level is set for "up", activating the relay when the display exceeds the setpoint value. Hysteresis is set for 1, to reduce chatter in the relay, and the time delay is set for 0. The relay status is normally energized (nE).

The Analog signal is connected to a strip chart recorder, and will emit a 0.1 mV/digit

(displayed) signal. The formula for the output signal is:

$$\text{mV} = (\text{RDG} / 10) \times (\text{number of digits})$$

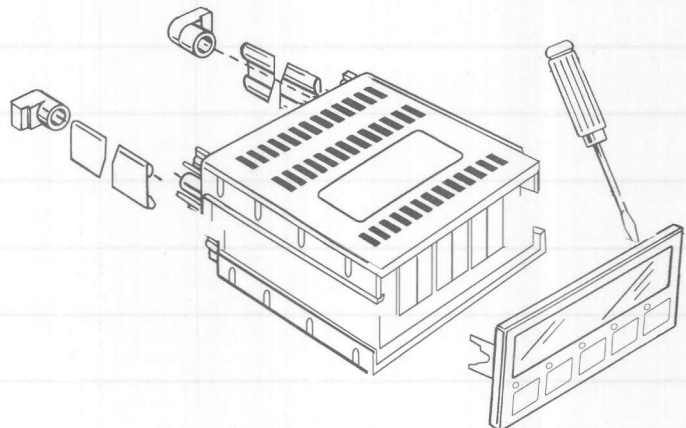
Where RDG = Displayed Value and mV = Output Voltage (mV)
In this example, when the display shows 95.50 Ω , the Hawk sends a 955 mV (9.55 V) output signal to the chart recorder. This will present a continuous monitoring of the displayed value. The analog signal is sent from terminals # 12A and #11A. These connections are on the upper edge connector on the Hawk.

In addition, the analog output signal has overrange and underrange logic outputs available from terminals #7A and #9A, respectively. When an overrange condition occurs, a 5 VDC signal is available. In an underrange situation, the analog signal is 0 VDC. These signals can be connected to a light, turning on in an overload situation, alerting the operator of the overload condition.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts inside or user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it on to the case. Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.



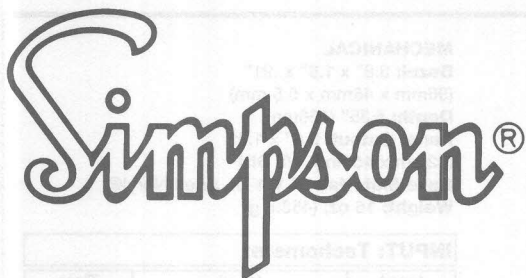
**B
1
8
8****WARNING**

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Engineers Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Tachometer Controllers

Hawk HK40 Series 4 Digit

- **Easily Programmed From the Front Panel**
- **Software Functions Include:**
 - Password
 - One, or Two Setpoints
 - Time Delay & Hysteresis
 - Display Scaling
 - Decimal Point Selection
- **Display Hold**
- **2 Piece Screw Terminal Connector for Easy Installation**
- **1/8 DIN Case, Made of High Impact Noryl®**
- **3 Tachometer Functions: A (2-30 VRMS), B (8.2VDC/1K Ω), D (On/Off)**
- **Optional Nema 4 Front Panel Cover**
- **Optional 5 Amp Relays and Analog/Digital Outputs**
- **4 digit, 0.56" (14.2 mm) High Bright Red LED Display**



B
189

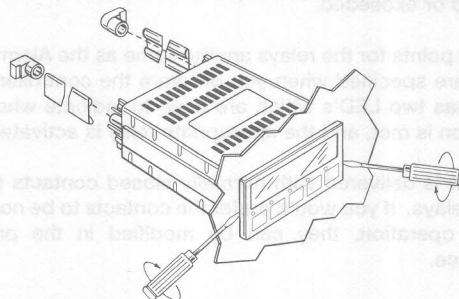
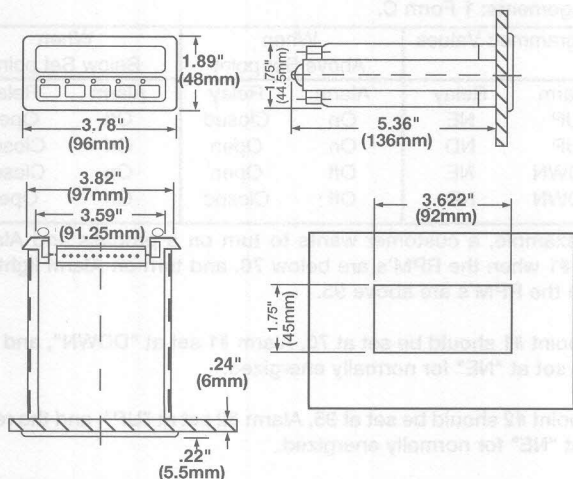
Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include programmable decimal point and a password lockout feature. By using

the password feature, the controller's programming functions and set points are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl® plastic. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for wash down environments. A two piece screw terminal is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2mm).

Decimal Point: 3 position software programmable from front panel.

Overrange: Display (flashing) indicates maximum reading (Hi).

Underrange: Display (flashing) indicates minimum reading (Lo).

Alarm Indicators: Two LED indicators for alarm conditions on front panel

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA max.

ACCURACY @ 25° C

HK40: 0.02% of input ± 1 digit

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temperature Coefficient (per °C):
 ± 100 ppm/°C

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 70 dB (1 K Ω unbalanced) @ 50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Time Base: 1 Second

INPUT VOLTAGE

Type A: 2-30 VRMS

Type B: 8.2 VDC / 1K Ω (NAMUR Operation)

Type D: < 2V - level 0, > 6V - level 1 (Inductive and capacitive proximity switches and encoder)

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8"

(92mm x 45mm) 1/8 DIN

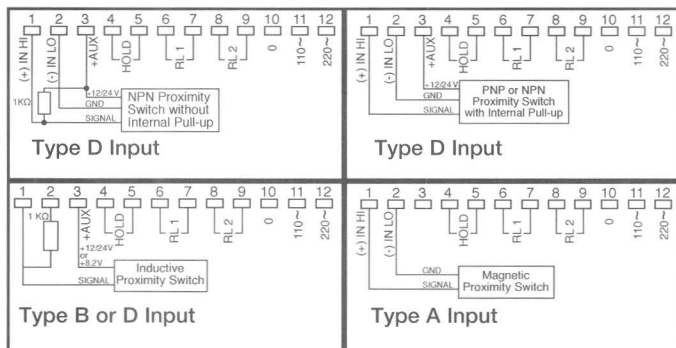
Case Material: 94 V-1 UL rated Noryl®

Weight: 16 oz. (453.6 g)

INPUT: Tachometer

Input Range	Input Frequency Range	Time Base
Type A 9999 RPM	2 Hz - 600 Hz	1 Second
9999 RPM	15 Hz - 150 KHz	1 Second
Type B 9999 RPM	2 Hz - 600 Hz	1 Second
9999 RPM	15 Hz - 150 KHz	1 Second
Type D 9999 RPM	2 Hz - 600 Hz	1 Second
9999 RPM	15 Hz - 150 KHz	1 Second

Wiring Diagram



Input Signal:

Connect the input signal to the terminals specified in the diagrams to the left.

Input Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold: This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held (allowing a reading to be taken). To re-activate the display, remove the short between the two terminals.

Relays

Up to two relays are available for the Hawk controller. The relays are 5 amp, 250 VAC, DPST models. The functions of the relays are defined in the programming mode. The functions include the set point, the alarm level, hysteresis, time delay, and status of each relay.

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the output when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without soldering or unsoldering them.

The bottom chart shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,

4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on a process and Alarm light #1 when the RPM's are below 70, and turn on Alarm light #2 when the RPM's are above 95.

Set point #1 should be set at 70, Alarm #1 set at "DOWN", and the relay set at "NE" for normally energized.

Set point #2 should be set at 95, Alarm #2 set at "UP", and the relay set at "NE" for normally energized.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. The input variable is not monitored during the programming sequence. The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The ▲ and ▼ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2" LED's will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the ▲ or ▼ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dP)

The display will show "dP" for 1 second. The display will then show "1111" and the "PV" LED will be flashing. The current decimal point position will be displayed. To change to position of the decimal point, press the ▲ or ▼ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Selecting the number of pulses/revolution (COGS)

The display will show "COGS" for about 1 second. Use the ▲ and ▼ keys to change the indicated value of COGS (pulses/revolution) to a different value. Check the Formula section for help in calculating RPM, Frequency, and number of pulses per revolution.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" for 1 second, then the stored value will be displayed. This value is expressed in RPM, and generally this value is 0.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the ▲ or ▼ keys until the desired value is displayed. Press "ENTER" to lock in the "LoE" value.

"HiE" will appear for 1 second, then the stored value will be displayed. In the Hawk Tachometers this value is expressed in RPM's, and is set with a default of 9999 RPM's. To retain this value, press "ENTER". To modify the "HiE" value, use the ▲ and ▼ keys. Press "ENTER" to lock in the new value.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display different values.

For example:

Electrical Input Range : 0 to 9999 RPM (LoE to HiE)
Programmed Display Scaling: 0 to 1000 Feet (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed

value corresponding to the input range. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. Our example above has a "Hi" of 1000 (feet). Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The setpoint is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The setpoints can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show setpoint #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored setpoint value is displayed, and can be changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the setpoint value (at which the alarm is enabled) and the value at which you want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status Normally Energized ("nE"), while the ▼ key will make the status Normally De-energized ("nd").

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second setpoint.

Exiting Programming mode

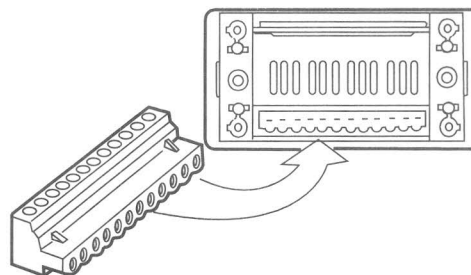
After programming the relay(s), the Hawk automatically exits the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +3\text{ V}$	$0 \leq +15\text{ V}$
$1 \leq -3\text{ V}$	$1 \geq -15\text{ V}$

Typical Input Impedance: 5K Ω

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +5\text{ V}$	$0 \leq +13\text{ V}$
$1 \leq -5\text{ V}$	$1 \geq -13\text{ V}$

Load Resistance: 3K Ω to 7K Ω

RS 422

Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

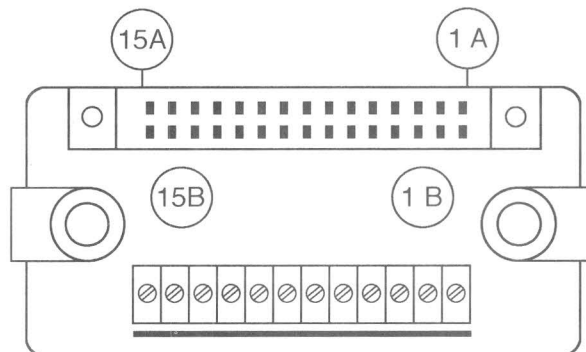
Inputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2\text{ V (diff)}$	$0 \leq +12\text{ V (diff)}$
$1 \leq -0.2\text{ V (diff)}$	$1 \geq -12\text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5\text{ V (diff)}$	$0 \leq +5\text{ V (diff)}$
$1 \leq -1.5\text{ V (diff)}$	$1 \geq -5\text{ V (diff)}$

Termination Resistances : 100 Ω $\pm$ 10%



(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.

CTS = Clear to send (computer ready to receive data)

RTS = Request to send (Hawk ready to transmit data)

TX = Transmit data (data transmission from Hawk)

RX = Receive data (data reception from computer)

SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
853 Dundee Ave.
Elgin, IL 60120
(708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

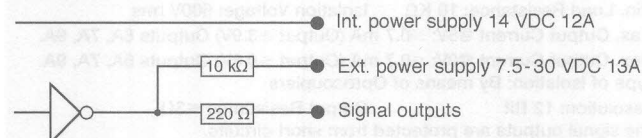
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by creating a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart below for all the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A



IOFF(Max) = 250 μ A @45°C
ION (Max) = 10 mA

Digital Signal Outputs

1st digit(1sd)	2nd digit	3rd digit	4th digit
Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B
2 2B	20 2A	200 6B	2,000 10B
4 3B	40 3A	400 7B	4,000 11B
8 4B	80 4A	800 8B	8,000 12B

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Internal Power supply V+	12 A
Ext. Open Coll. Pow. Supply	13 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 22 to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign. Each data group can be selected by means of 3 "Enable" lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 Enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 is ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin
Burn-out	6 A
Overrange	7 A
Sign(*)	8 A (*) Negative = logical status 1
Underrange	9 A Positive = logical status 0
Ground	10 A
Enable 1	13B
Enable 2	14B
Enable 3	15B

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*)
	(*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mA DC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35)
- 5) 0.1 mVDC / digit (HK45)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for DC Voltage controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mA DC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A
0.1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mA DC:

$$I = (16/HI-LO) \times (RDG-LO) + 4$$

I = Output Current (mA)

HI = Max. programmed value of the whole measuring range

LO = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - LO) / (HI - LO)$$

V = Output Voltage (V)

HI = Max. programmed value of the whole measuring range

LO = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C (HK 35)

Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

The signal outputs are protected from short circuits.

0.1 mVDC / digit:

$$mV = (RDG / 10) \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.001 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

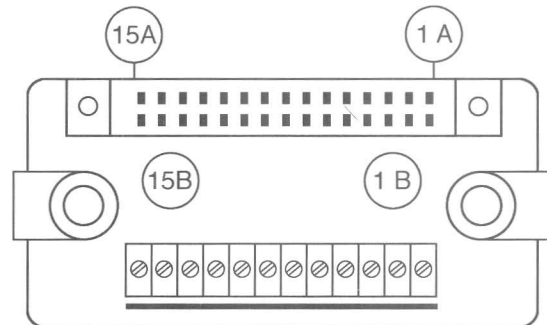
Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Resolution: 12 Bit

Output Resistance $\leq 3\Omega$

The signal outputs are protected from short circuits.



Formula

Relationship between rotational speed, frequency, and number of pulses/revolution

This relationship uses the following formula:

$$RPM = (F \times 60) / N$$

Relationship between linear speed, frequency, and number of pulses/revolution.

This relationship uses the following formula:

$$V = (RPM \times S) / 60$$

Where:

RPM = revolutions per minute (rotational speed)

F = input frequency of the instrument in Hz

N = pulses per revolution generated by the proximity switch, corresponding to COGS.

V = linear speed in mm/s, cm/s, or m/s, corresponding to the displayed value.

S = Linear development of capstan circumference per revolution

Note that the following formulas can be derived:

$$F = (RPM \times N) / 60$$

$$N = (F \times 60) / RPM$$

It is advisable to check that the minimum and maximum frequency generated by the transducer be within the frequency range of the Hawk controller. This range is 15 Hz to 150 KHz, or 2 Hz to 200 Hz depending on the range selected when ordering the controller.

To have the highest resolution, the following relationship has to be maintained: $\{(HI-LO) / (HI-E-LO-E)\} \leq N$.

Where:

HI-E and LO-E = the input range

HI and LO = the display span

Application Example

It is desired to indicate the speed of a conveyor belt in feet/min. Underspeed and overspeed alarms are required if the speed of the conveyor falls below 175 ft/min or exceeds 325 ft/min, respectively. A proximity switch is used to sense a gear, with 30 cogs, coupled to a conveyor drive. The shaft speed rating is 500-1500 rpm and the circumference of the capstan is measured to be 15 feet.

The minimum and maximum input frequency can be determined as follows:

$$F = \frac{\text{RPM} \times N}{60}$$

$$F_{\min} = (500 \times 30) / 60 = 250 \text{ Hz}$$

$$F_{\max} = (1500 \times 30) / 60 = 750 \text{ Hz}$$

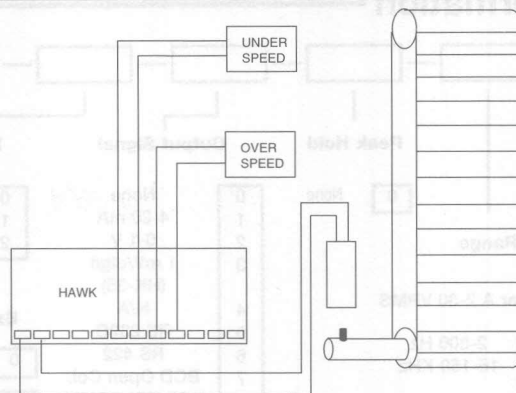
Also, the minimum and maximum linear speed of the conveyor can be determined:

$$V = \frac{\text{RPM} \times S}{60}$$

$$\text{Min. linear speed} = (500 \times 15) / 60 = 125 \text{ fps}$$

$$\text{Max linear speed} = (1500 \times 15) / 60 = 375 \text{ fps}$$

A Simpson Hawk Tachometer controller (Type D, 15Hz to 150 KHz) with dual relays will fit the application requirements. The 15Hz - 150KHz version is needed because the Fmax exceeds the 2 Hz- 600



Hz range of the other version.

The controller is wired per the diagram, and programming is accomplished as follows:

Basic Programming Steps

dp	1111
COGs	30
Loe	500
Hie	1500
Lo	125

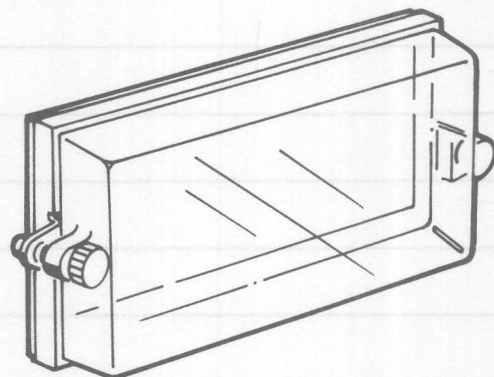
Hi	375
SP1	175
up/dn	dn
hys	0
del	0
nD/nE	nE
SP2	325
up/dn	up
hys	0
del	0
nD/nE	nE

NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

Catalog #45003.

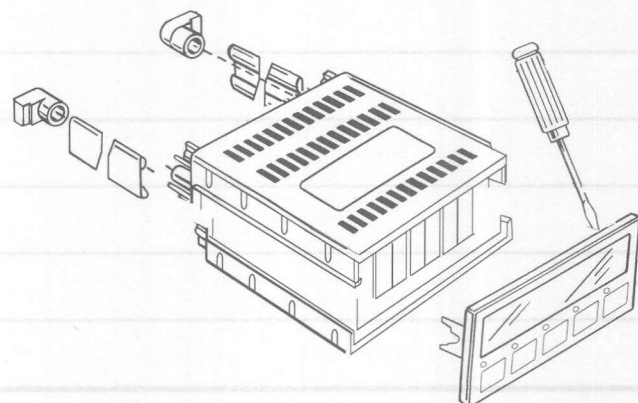


Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts inside, and there are few user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove screws, side retainers, and mounting brackets first.

Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case. Remove the "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit.

After you are finished, put the top shell back on the unit, and carefully replace the "O" rings on the back and the bezel on the front.



Ordering Information

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Power Supply

- 1 120 VAC
- 2 220 VAC
- 3 9-32 VDC

Range

Peak Hold

- 0 None

Output Signal

- 0 None
- 1 4-20 mA
- 2 0-1 V
- 3 1 mV/digit (HK-35)
- 4 N/A
- 5 RS 232C
- 6 RS 422
- 7 BCD Open Col.
- 8 BCD TRI-STATE
- 9 BCD O.C. W/ SEL. LINES
- A 0-10 V

Relays

- 0 None
- 1 One
- 2 Two

Excitation

- 0 Standard

- Type A 24V
- Type B 8.2V
- Type D 24V

Basic unit

- HK 40 4 Digit

Tachometer A 2-30 VRMS

- 111 2-600 Hz
- 112 15-150 KHz

Tachometer B 8.2 VDC / 1 KΩ

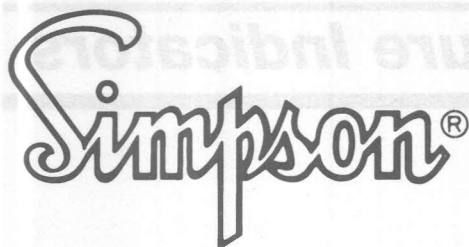
- 121 2-600 Hz
- 122 15-150 KHz

Tachometer D On/Off

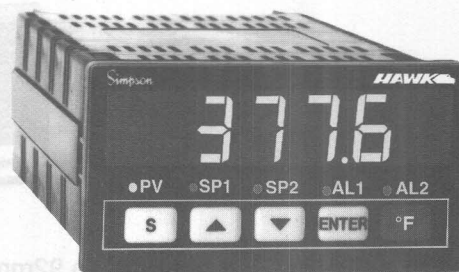
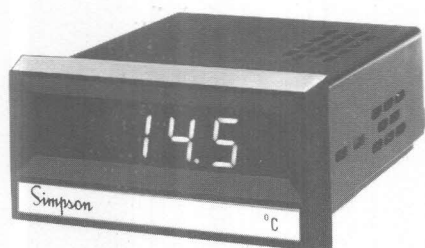
- 131 2-600 Hz
- 132 15-150 KHz

NEMA 4 Cover : Catalog # 45003

Engineers Notes



Temperature Indicators



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Simpson offers three styles of temperature measurement devices to fit your application needs.

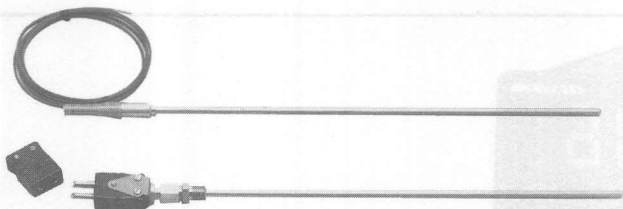
Simpson's line of temperature indicators/controllers are available in 2 different panel cutout sizes. The Falcon indicators and Hawk controllers are 1/8 DIN size, and both styles have 0.56" LED displays. The 2800 series indicators require a 92mm by 42.72 mm cutout, and offer the same 0.56" LED display.

All units feature 120/220 VAC power supply. The 2800 series have an optional 5 VDC power supply. The Falcon indicators and Hawk controllers have optional 9-32 VDC power supply.

Thermocouples are available for use with our meters. Types J, K, T, and E are custom made to your specified length with either a beaded end or a solid bare wire. There are 5 types of insulation available for the thermocouples, including Glass Braid and Double Glass Wrap.

Relays and Output signal options are available in the Hawk series controllers. Up to two relays can be installed in the Hawk controllers, permitting on-off control of your process. The relays are 5 Amp, 250 VAC, DPST models. Hysteresis and Time Delay are available in both the Hawk controllers. In addition, the Hawk offers Analog or Digital output signals. Analog signals include 4-20 mA, and 0-1 V signals. Digital Signals include RS 232/RS 422, as well as BCD output signals.

If remote monitoring of your temperature process is called for, a temperature transmitter will work better than running long lengths of thermocouple wire. It will be more economical over greater distances to use a 4-20 mA transmitter. The thermocouple is attached to the transmitter, which can be located in a thermal well near the testing site. Normal signal wire is run from the transmitter to a 4-20 mA process indicator/controller. Simpson offers a complete line of 4-20 mA process indicators/controllers which can be easily scaled in the field to accurately display the temperature you are monitoring. See the Process Indicators section of this Guide for further details.



Additional information on thermocouples and other temperature probes can be found in the Accessory section of this book.

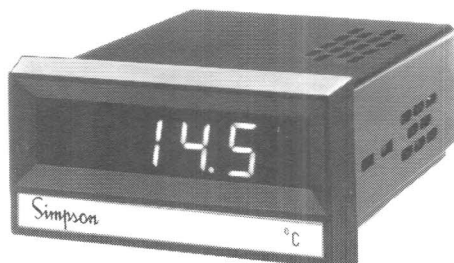
Display Hold is standard on all of our digital indicators/controllers. This allows the operator to "freeze" the display to take a reading of the temperature signal.





Temperature Indicators

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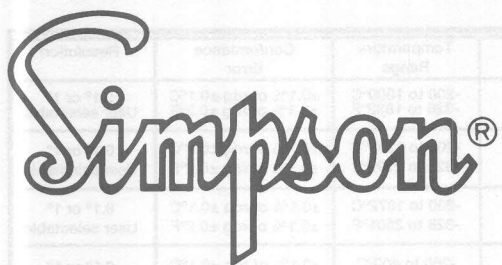
The 2800 series indicators require a 92mm x 42.72mm cutout. The large 0.56" display is easy to read at a distance in low light areas. The 2871 requires a 117 VAC power supply, and the 2872 requires a 5 VDC power supply. Both use a sub-miniature connector to attach the thermocouple to the meter. The meter has a 3-1/2 digit, 0.56" Orange display, making it easier to view in low light and ambient light areas. 4 Temperature ranges are available: 0-200 °F, 0-1200 °F, 0-200 °C, and 0-1200 °C.



The Falcon F45 uses a precision microprocessor design to monitor temperature signals. The Falcon F45 can accept a signal from the following thermocouple options: J, K, S, T, E, and R. In addition, RTD Pt100 and mV signals can be monitored by this meter. The high quality, 4-1/2 digit display can be protected by an optional NEMA 4 cover, and can be easily scaled in the field. The decimal point can be easily changed in the field by jumpers on the main board. In addition, the input ranges are user selectable and can be changed without recalibrating the indicator. The 0.56" high red LED allows easy viewing of the display from a distance.



The feature packed Hawk Controller requires an 1/8 DIN cutout, and offers password protection, wide range display scaling, a two piece screw terminal connector, display hold, and optional NEMA 4 cover. Options include Analog or Digital output signals. Dual relays are available, converting the Hawk to an On-Off temperature controller. Hysteresis and Time Delay are standard for programming the set points. The Hawk can monitor J, K, R, and S type thermocouple signals, as well as RTD Pt100 and RTD Ni100 signals. Front panel buttons handle all of the programming variables, and password protection locks out unwanted access to programming features.



Temperature Indicators

Falcon F45 Series 4-1/2 Digit

- Full 4-1/2 Digit, Bright Red 0.56" (14.2mm) Display
- Precision Microprocessor Design
- User programmable T/C or RTD type (J, K, E, T, R, S, and Platinum 100 RTD)
- Jumper Selectable Display Indicates °C or °F With 0.1° or 1° Display Resolution
- Linear mV Scale for Easy Calibration
- Short 3.01" (76.5mm) Deep, 1/8 DIN Case
- Screw Terminal Connector for Easy Installation
- Optional NEMA 4 Splash-Proof Lens Cover
- Optional Isolated 9-32 VDC Power Supply



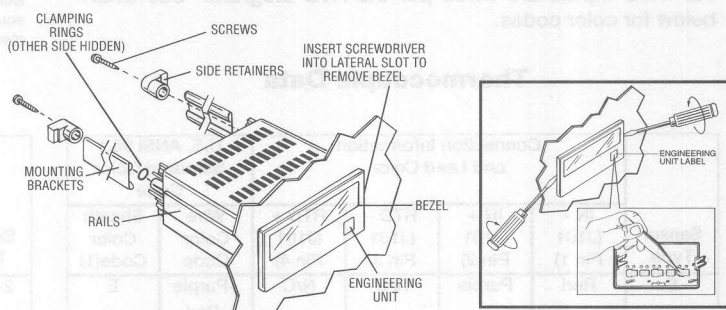
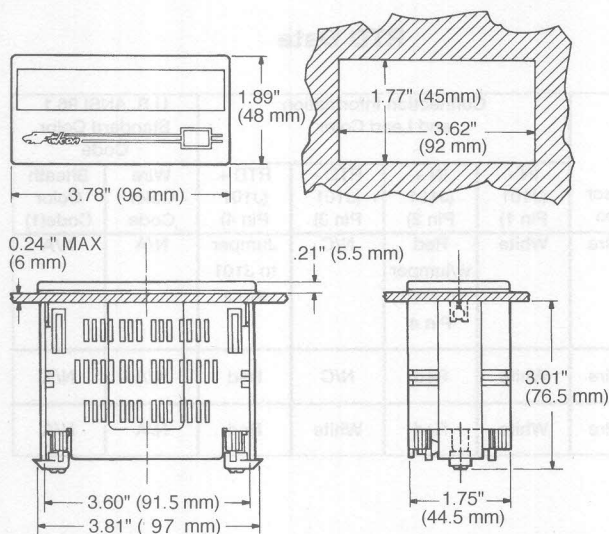
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The Falcon Series temperature indicator is a high accuracy, microprocessor based panel instrument designed to provide the maximum flexibility in temperature measurement. The Falcon automatically compensates for differences between unit temperature (room temperature) and ice point (0°), and provides the complete NIST ranges for six thermocouple types

as well as Platinum 100 RTD. Input ranges are user selectable and can be changed without recalibrating.

The Falcon series features a standard 1/8 DIN case with a depth of 3.01" (76.5 mm). Screw terminals are standard for easy installation. A NEMA 4 splash-proof lens cover is available for wash-down areas.

Installation and Panel Cutout



Mounting Instructions

The Falcon series 1/8 DIN indicators require a panel cutout of 1.77" (45mm) high by 3.62" (92 mm) wide. To install the Falcon into a panel cutout, remove screws and side retainers from rails as shown above. Position panel meter into cutout through the front opening. From the rear of panel, slide panel mounting brackets back onto rails until rails are flush against back of panel. Replace side retainers and screws.

Engineering Label Placement

If placement of the engineering unit label is required, insert a small Flathead screwdriver into the lateral slot on side of bezel and gently turn screwdriver until bezel snaps away from case. Use tweezers to remove and replace engineering unit label. Snap bezel back in place.

Specifications

DISPLAY

Type: 7 segment, red LED

Height: 0.56" (14.2mm)

Decimal Point: Jumper selectable 2 position (corresponding to resolution desired)

Overrange indication: 1 and 4 LSD blank with polarity sign.

Polarity: Automatic, with "-" indication, "+" indication implied.

POWER REQUIREMENTS

AC Voltages: 120 or 220 VAC, $\pm 10\%$

DC Voltages: 9-32 VDC

Power Consumption: 3VA

ENVIRONMENTAL

Operating Temperature: 0 to 55°C

Storage Temperature: -10 to 60°C

Relative Humidity: 0 to 85% non-condensing

Warm-up Time: Less than 20 minutes

MECHANICAL

Bezel: 3.8" x 1.9" x .22" (96 x 48 x 5.5mm)

Depth: 3.01" (76.5mm)

Panel Cut-out: 3.6" X 1.8" (92 x 45 mm 1/8 DIN)

Case Material: 94V-1, UL rated Noryl®

Weight: 9 oz. (255.1 g)

INPUTS

Thermocouple: J, K, E, T, R, and S

RTD: Platinum 100

Millivolt: ± 84 mV reading of uncompensated mV

Cold Junction Compensation Error: 0.1°C/°C

Input Impedance: 10 M Ω (typical)

Lead Resistance Effect: 4.0 μ V/100 Ω

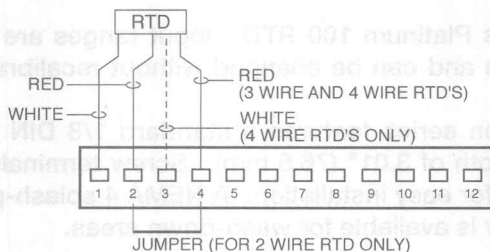
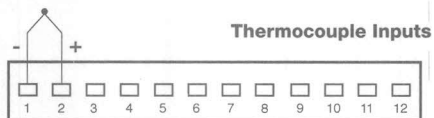
Conversion Rate: 2-1/2 times per second

Open Thermocouple Detection: -1 on display, -40 nA bias on thermocouple

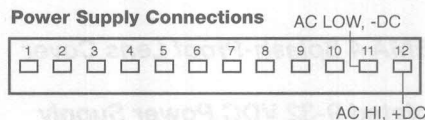
Sensor Type	Temperature Range	Conformance Error	Resolution
E	-200 to 1000°C -328 to 1832°F	$\pm 0.1\%$ of rdg $\pm 0.1^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{F}$	0.1° or 1° User selectable
J	-200 to 1200°C -328 to 2192°F	$\pm 0.1\%$ of rdg $\pm 0.1^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{F}$	0.1° or 1° User selectable
K	-200 to 1372°C -328 to 2501°F	$\pm 0.1\%$ of rdg $\pm 0.1^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{F}$	0.1° or 1° User selectable
T	-200 to 400°C -328 to 752°F	$\pm 0.1\%$ of rdg $\pm 0.1^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{F}$	0.1° or 1° User selectable
R	-50 to 1768°C -58 to 3214°F	$\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.4^\circ\text{F}$	1° Automatic
S	-50 to 1768°C -58 to 3214°F	$\pm 0.1\%$ of rdg $\pm 0.2^\circ\text{C}$ $\pm 0.1\%$ of rdg $\pm 0.4^\circ\text{F}$	1° Automatic
mV	-19.999 to +4.000 mV	$\pm 0.02\%$ of rdg* ± 0.002 mV	0.001 or 0.01 mV* User selectable
RTD Pt 100	-200 to 850°C -328 to 1562°F	$\pm 0.06\%$ of rdg $\pm 0.1^\circ\text{C}$ $\pm 0.06\%$ of rdg $\pm 0.2^\circ\text{F}$	0.1° or 1° User selectable

* Usable resolution of 0.002 mV. Conformance is to NIST Monograph 175. **Temperature-Electromotive Force Functions for the Letter-Designated Thermocouple types based on the ITS-90.**

Wiring Diagrams



Input Signal: Connect the thermocouple to terminals #1 and #2. RTD inputs are wired per the RTD diagram. See Chart below for color codes.



Power Supply: Connect the power supply to terminals #11 and #12. #11 is for AC neutral and -DC, and terminal #12 is for AC Hot and +DC.

WARNING

- * Before making any electrical connections, make sure all power is off.
- * Do not touch leads, circuit, or the instrument while power is applied.
- * Make sure the hook-up wire is capable of carrying the current required and is well insulated, with no cracks or exposed wiring.

CAUTION

Before switching instrument on, make sure the supply voltage matches the power source required as indicated on model identification label affixed to the top of the meter.

Thermocouple Data

Sensor Type	Connection Information and Lead Color				U.S. ANSI 96.1 Standard Color Code	
	IN - (J101 Pin 1)	IN + (J101 Pin 2)	RTD - (J101 Pin 3)	RTD + (J101 Pin 4)	Wire Color Code	Sheath Color Code(1)
E	Red	Purple	N/C	N/C	+Purple -Red	E
J	Red	White	N/C	N/C	+White -Red	J
K	Red	Yellow	N/C	N/C	+Yellow -Red	K
R	Red	Black	N/C	N/C	+Black -Red	R
S	Red	Black	N/C	N/C	+Black -Red	S
T	Red	Blue	N/C	N/C	+Blue -Red	T

(1) Non-Metallic thermocouple sheaths may be a single color, or striped with the second color.

RTD Data

Sensor Type	Connection Information and Lead Color				U.S. ANSI 96.1 Standard Color Code	
	IN - (J101 Pin 1)	IN + (J101 Pin 2)	RTD - (J101 Pin 3)	RTD + (J101 Pin 4)	Wire Color Code	Sheath Color Code(1)
2-Wire	White	Red w/jumper to J101 Pin 4	N/C	Jumper to J101 Pin 2	N/A	N/A
3-Wire	White	Red	N/C	Red	N/A	N/A
4-Wire	White	Red	White	Red	N/A	N/A

Function Set-Up and Range

Thermocouple and RTD selections are made on the Main board as shown in the table and diagram to the right.

To gain access to the Main board and the Display board, the meter must be opened. Use the following procedure:

WARNING

Disconnect power supply and all connections before opening case

- 1) Disconnect all wires from terminal block.
- 2) Remove meter from panel mount.
- 3) Remove screws, side retainers, and panel mounting brackets.
- 4) Remove bezel and clamping rings from back of meter.
- 5) Separate top half from bottom half.

THERMOCOUPLE OR RTD SELECTION

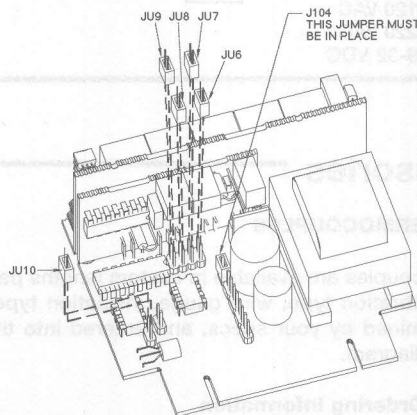
The thermocouple or RTD selection is made by placing push on jumpers at the designated positions on the main board. See the table and diagram to the right for location and placement.

EXAMPLE 1: To configure the meter for a J type thermocouple, no jumpers are required on JU 6, JU 7, JU 8, or JU 9. A push on jumper is positioned on JU 10 only.

EXAMPLE 2: To configure the meter for a 3-wire RTD, push on jumpers are positioned on JU 9 and JU 10 only. No jumpers are required on JU 6, JU 7, or JU 8.

NOTE: Additional jumpers are included for alternate range and scaling selections.

Sensor Type	Jumper Identification				
	JU 6	JU 7	JU 8	JU 9	JU 10
Thermocouple					
J	OUT	OUT	OUT	OUT	IN
K	IN	OUT	OUT	OUT	IN
E	OUT	IN	OUT	OUT	IN
T	OUT	OUT	IN	OUT	IN
R	IN	IN	OUT	OUT	IN
S	IN	OUT	IN	OUT	IN
mV	IN	IN	IN	IN	IN
RTD SENSORS					
2 wire RTD	OUT	OUT	OUT	IN	IN
3 wire RTD	OUT	OUT	OUT	IN	IN
4 wire RTD	OUT	OUT	OUT	IN	OUT



Set-up

UNIT MEASUREMENT AND RESOLUTION

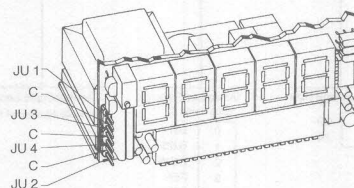
These selections are made on the display board, located on the front left side of the display (see diagram). Push-on jumpers (on JU 1 and JU 2) are used to make your selection. The Fahrenheit / Celsius unit of measurement is selected by using jumper JU 2, and the resolution of the meter is determined by using jumper JU 1. You can select a resolution of either 0.1° or 1.0° for thermocouple types J, K, T, E, or RTD sensors only. Due to inherent characteristics, types R and S must have 1.0° resolution.

Jumper JU 1	
°C	N/A
°F	N/A
0.1°	OUT
1°	IN

Jumper JU 2	
°C	IN
°F	OUT
0.1°	N/A
1°	N/A

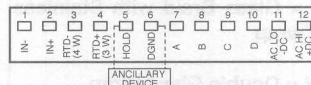
CAUTION

When connecting the ancillary device, ensure that DGND and the ancillary device are at the same potential, or are properly isolated. Failure to do so may result in equipment damage or undesirable ground loops.



Display Hold

This standard feature allows you to hold the displayed value indefinitely. To activate this feature, create a short circuit across jumpers # 5 and #6 with an ancillary device (such as a switch or computer). To restore the meter to normal display mode, remove the short circuit.



Calibration Procedure

Equipment Required:

- 1 - DC Calibrator
- 1 - J type cold junction compensator
- 1 - Decade resistance box - .01Ω resolution.
- or
- 1 - Thermocouple Calibrator
- 1 - Decade resistance box - .01Ω resolution.

Setup

- 1) Insert the following jumpers
JU 6, JU 7, JU 8, JU 9, JU 10
- 2) Connect power to J101 pins 11 & 12
- 3) Connect a short across J101 pins 1 & 2.

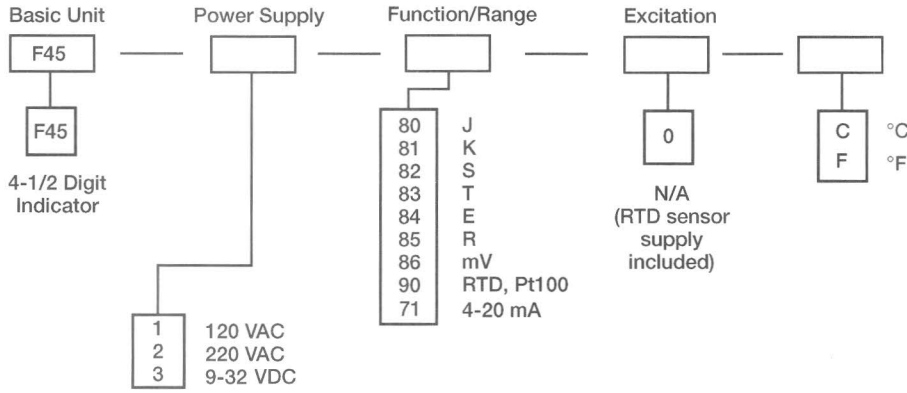
Equipment Required: DC Calibrator

- 1) Warm up test equipment and meter for 15 minutes or until stable.
- 2) Short JU 2 to C and reboot meter. After the setup menu appears, release JU 2.
- 3) Scroll through the setup menu by shorting and releasing JU 1 to C until "C-F?" appears. Short and release JU 2 to C to enable the menu selection. Short and release JU 3 or JU 4 to C until "F" is displayed.
- 4) Short and release JU 1 to C until "rES?" appears. Short and release JU 2 to C to enable the menu selection. Short and release JU 3 or JU 4 to C until "0.1" is displayed.

- 5) Short and release JU 1 to C until the display blanks and the measurement mode appears.
- 6) Allow display to stabilize for 15 seconds and then simultaneously short both JU 3 and JU 4 to C for 1 second.
- 7) Remove the short across J101 pins 1 and 2. Connect the negative lead of the calibrator to pin 1 and the positive lead to pin 2. Input 80mV and adjust reading for 80.000 within ±0.005mV.
- 8) Remove JU 9 and reboot the meter. Connect adequate setting time for all thermal transients to settle. Set calibrator for 32.0°F. Short and release JU 3 to C to increase (or short and release JU 4 to C to decrease) the meter reading until it reads 32.0°F ±0.1°F. Allow 3 to 5 minutes for the unit to stabilize. When satisfied with the setting, simultaneously short both JU 3 and JU 4 to C for 1 second.
- 9) Remove JU 6, JU 7 and JU 8 and replace JU 9. Connect the calibrator set for RTD mode (or attach the Decade Resistance Box) to the meter by attaching the "+" leads to J101 pins 2 and 4. Attach the "-" leads to J101 pin 1. Reboot the meter while shorting JU 4 to C. Set the calibrator for 32.0°F (100.0Ω ±0.1Ω for the decade resistance box). Short and release JU 3 to C to increase (or short and release JU 4 to C to decrease) the meter reading until it reads 32.0°F ±0.4°F. Set the calibrator for 1562.0°F (390.26Ω ±0.1Ω for the decade resistance box). Verify that the meter reads within 1.0°F. If not, use JU 3 and JU 4 to adjust the reading. Verify that the 32.0° reading is still in spec. When satisfied with the setting, simultaneously short JU 3 and JU 4 to C for 1 second.

Ordering Information

Safety Symbols



WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all the instrument.

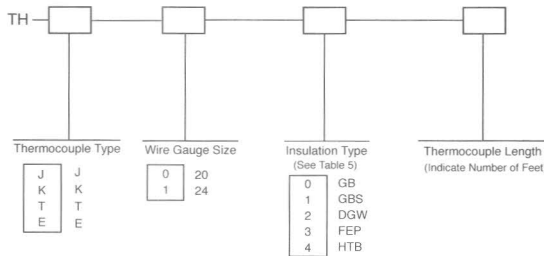
Accessories

INSULATED THERMOCOUPLES

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

Thermocouple Ordering Information

(Termination End: HJ-Beaded, CJ-Solid Bare Wire)



Thermocouple Insulation Types Available

Type	T/C Type	Gauge Size	GB = Glass Braid
GB	J, K, and T	20 and 24	GBS = Glass Braid with Stainless steel wrap
GBS	J and K	20	DGW = Double Glass Wrap
DGW	J and K	24	FEP = High temperature plastic equal to Teflon® (registered trademark of Dow Chemical)
FEP	J and K	20	HTB = High Temperature Glass Braid
HTB	E	20	

THERMOCOUPLE PROBES (QUICK DISCONNECT)

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

THERMOCOUPLE PROBES (48 INCH LEAD WIRE)

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads. An adjustable compression fitting is available separately. See the table below for ordering information.

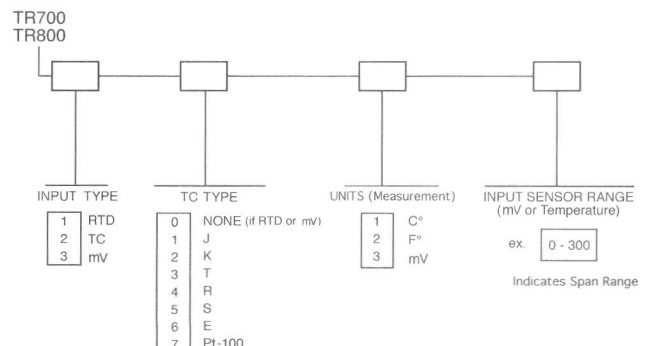
Type	Catalog Numbers				
	ANSI Color Code	Quick Disconnect Assembly	48 Inch Lead Wire Assembly	Plug Only	Jack Only
J	Black	21238	21242	21245	21249
K	Yellow	21239	21243	21246	21250
T	Blue	21240	-----	21247	21251
E	Purple	21241	-----	21248	21252
RTD	-----	-----	21244	-----	-----

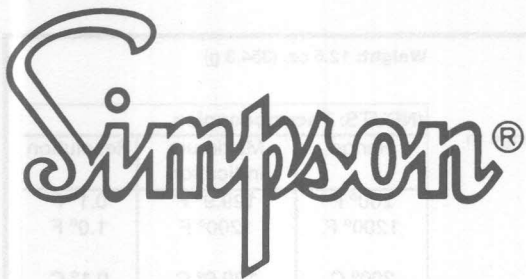
Note: a 3/16" compression fitting is available separately for assemblies. Catalog Number 21253.

Transmitters (For use with Falcon 4-20 mA Indicator)

Isolated and Non-Isolated

Simpson offers isolated (TR-700) and non-isolated (TR-800) two-wire transmitters which fit in standard size thermal heads. These indicators work with Simpson 4-20 mA process indicators, and are for use where high noise and/or long distances make direct thermocouple applications impractical. If your application changes, the field ranging kit (catalog number 21254) provides recalibration information for your transmitter.

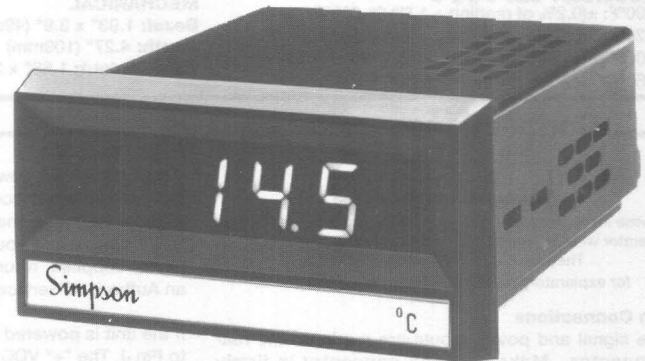




Temperature Indicators

2871 & 2872 Series 3-1/2 Digit

- 4 Ranges: 200° F, 1200° F, 200° C, 650° C
- Designed for J Type Thermocouple Inputs
- Fast Step Response Time
- Input/Output Edge Connector
- 3-1/2 digit, 0.56" Orange LED Display
- Models 2871 Requires 120 VAC Power Supply
- Models 2872 Requires 5 VDC Power Supply
- Additional Rear Terminal Connector Available
- Optional Cutout Adapters
- Optional "U" Shaped Mounting Bracket
- Optional Display Hold

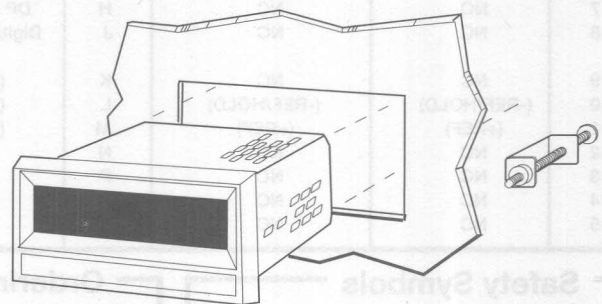
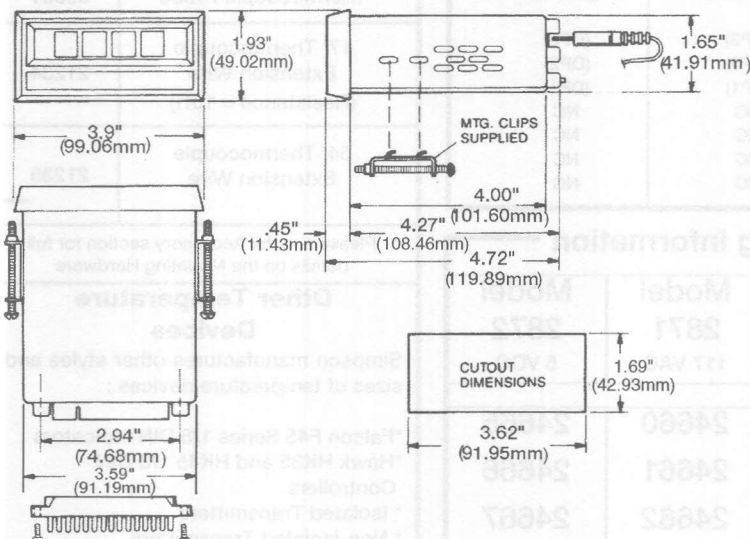


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Simpson's 2871/2872 Series Temperature meters offer high accuracy with fast step response time. The 2871 is available in a 240 VAC power supply version (available from Simpson or one of our Authorized Service Centers). These meters have a wide 0-85% humidity operating range, automatic polarity, and overrange indication. The large 3-1/2 digit display (0.56" high) is easily readable from a distance. Panel cutout adapters are available for 1/8 DIN panel

cutouts, and for older "Nema" sized cutouts. In addition, a large "U" shaped mounting bracket is available for applications where the panel strength is unknown or weak. Optional Display Hold can be activated from the rear connector, and activated with a switch (not supplied). Thermocouples are ordered separately from the meter (maximum allowable resistance is 50Ω, with a maximum length of 50 feet of 24 gauge wire).

Installation and Panel Cutout



Mounting Requirements

The 2869 and 2870 indicators are installed with the mounting hardware provided. Slide the meter through the panel cutout. Next, insert a side mounting bracket to each side of the meter. Use the two holes located near the bezel to attach them to the meter. Slide the brackets back until they lock into the meter. Turn the screws in each bracket until they firmly contact the panel surface. Attach the wiring connections to the meter.

Specifications

DISPLAY

Type: 7 segment, Orange LED

Height: 0.56" (14.2mm)

Decimal point: Fixed with Range

Overrange indication: Digits blank except "1"

POWER REQUIREMENTS

AC Voltage: 120 V, $\pm 10\%$, 50 Hz to 400 Hz, 5VA

DC Voltage: 5 V, $\pm 5\%$ at 400 mA

Rated Circuit to Ground Voltage: 250 VDC

ACCURACY @23°C $\pm 2^\circ\text{C}$

200°F: $\pm(0.2\%$ of reading $+ 1.8^\circ$) 0°-200°F

1200°F: $\pm(0.2\%$ of reading $+ 2.0^\circ$) 150°-1000°F

200°C: $\pm(0.2\%$ of reading $+ 2.5^\circ$) -30°-200°C

650°C: $\pm(0.2\%$ of reading $+ 2.0^\circ$) 50°-535°C

ENVIRONMENTAL

Operating Temperature: 0 to 40°C

Storage Temperature: -40 to 60 °C

Relative Humidity: 0 to 85%, non-condensing

Cold Junction Compensation: $\pm 0.1^\circ/1^\circ$ change in ambient, 0-50°C

Warmup time: Less than 15 minutes

CONVERSION

Technique: Dual-Slope integration

Rate: 3 sample per second, nominal

MECHANICAL

Bezel: 1.93" x 3.9" (49mm x 99mm)

Depth: 4.27" (109mm)

Panel cutout: 1.68" x 3.622" (42.72mm x 92mm)

Weight: 12.5 oz. (354.3 g)

INPUTS: Thermocouples

Range	Maximum Indication	Resolution
200° F 1200° F	199.9° F 1200° F	0.1° F 1.0° F
200° C 650° C	199.9° C 650° C	0.1° C 1.0° C

Connections

WARNING

These instruments are designed for maximum safety to the operator when mounted in a panel according to instructions.

They are not to be used unmounted or for exploratory measurements in unknown circuits.

Pin Connections

The signal and power inputs are made on the rear connector. Make sure the connector is firmly attached to the meter. Connections for each pin are summarized in the table below. Additional connectors are available. This allows the meter to be used in multiple locations by moving it from connector to connector.

Display Hold

This is an optional feature that must be specified when ordering. By shorting Pin 10 to Pin J, the displayed value can be held indefinitely. This short can be controlled by a switch (not supplied). This will allow the operator to flip the switch (holding the display), and to take a reading. The switch is then turned off, and the display functions normally again. This feature is available from the factory or from one of our Authorized Service Centers.

Power Supply

If the unit is VAC powered, attach the neutral to Pin C. The Ground is connected to Pin #1 and A. The High (or Hot) is connected to Pin E. If your application changes and you want the unit to be 220 VAC power supplied, return the unit to our factory or to an Authorized Service Center.

If the unit is powered by VDC, attach the VDC return to Pin J. The "+" VDC is connected to Pin #4.

Input Signal

The Thermocouple wire is attached to the thermocouple input jack. A 4' long thermocouple probe is available with the correct sub-miniature jack (see Accessories). Additional wire may be attached to this probe, and can be purchased through Simpson.

In addition, extension wire is available in 17' and 34' lengths for applications requiring a remotely located meter. This extension wire needs to be connected to the thermocouple probe (Catalog number 00391). See the Accessory section for further details on Type J thermocouples and probes.

Pin Number	2871 Circuit	2872 Circuit	Pin Number	2871 Circuit	2872 Circuit
1	3rd wire GND	5 VDC Return	A	3rd wire GND	NC
2	NC	NC	B	NC	NC
3	NC	NC	C	120 VAC Neutral	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	120 VAC High	NC
6	NC	NC	F	NC	NC
7	NC	NC	H	DP Common	DP Common
8	NC	NC	J	Digital Common	Digital Common
9	NC	NC	K	(DP3)	(DP3)
10	(-REF/HOLD)	(-REF/HOLD)	L	(DP2)	(DP2)
11	(+REF)	(+REF)	M	(DP1)	(DP1)
12	NC	NC	N	NC	NC
13	NC	NC	P	NC	NC
14	NC	NC	R	NC	NC
15	NC	NC	S	NC	NC

Theory of Operation

Signal Input Conditioning

The thermocouple output voltage, which is proportional to the temperature being measured, is applied to the thermocouple input jack. The cold junction compensation circuit monitors the ambient temperature and generates a correctional voltage that offsets ambient temperature variations at the thermocouple output. The temperature range of the instrument is determined by selected fixed amplifier gains.

Analogue-to-Digital Converter

The analogue-to-digital conversion is accomplished by the dual-slope integration technique. The DC voltage from the signal input conditioning section is converted by the LSI circuitry to a digital value equal to the parameter (temperature) being measured.

Readout

The readout section consist of the 3-1/2 digit, 7 segment, Orange LED display which is directly driven by the A/D converter.

Accessories

1/8 DIN Panel Adapter	22992
Domestic Panel Cutout (1.68" x 3.92")	22993
"U" Type Mounting Bracket	22991
Thermocouple Probe	00391
17' Thermocouple Extension Wire (Resistance = 10Ω)	21234
34' Thermocouple Extension Wire	21235

Please see the Accessory section for full details on the Mounting Hardware

Other Temperature Devices

Simpson manufactures other styles and sizes of temperature devices :

- *Falcon F45 Series 1/8 DIN Indicators
- *Hawk HK35 and HK45 1/8 DIN Controllers
- * Isolated Transmitters
- * Non-Isolated Transmitters
- * Thermocouples

Safety Symbols

WARNING

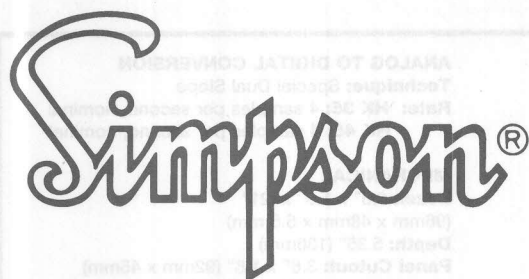
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Ordering Information

Range	Model 2871 117 VAC	Model 2872 5 VDC
200° F	24660	24665
1200° F	24661	24666
200° C	24662	24667
650° C	24663	24668



Temperature Controllers

Hawk HK35 & HK45 series 3-1/2 & 4-1/2 Digit

- **Easily Programmed From the Front Panel**
- **Software Functions Include:**
 - Password Display Scaling
 - One or Two Setpoints Decimal Point Selection
 - Time Delay & Hysteresis
- **3-1/2 Digit (°C) or 4-1/2 Digit (°F) Models, 0.56" (14.2 mm) High, Bright Red LED Display**
- **Display Hold**
- **2 Piece Screw Terminal Connector for Easy Installation**
- **1/8 DIN Case Made of High Impact Noryl®**
- **6 Temperature Options: J, K, R, S, RTD Pt 100, RTD Ni 100**
- **Optional Nema 4 Front Panel Cover**
- **Optional 5 Amp Relays and Analog/Digital Outputs**



B
2
0
5

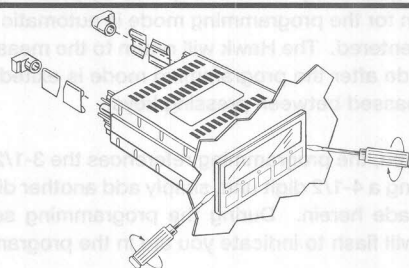
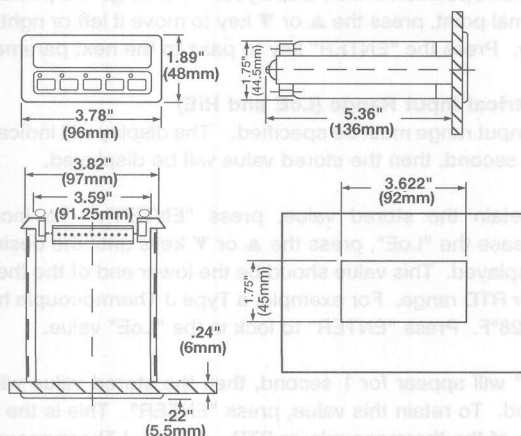
Simpson's Hawk Microprocessor based Controllers / Indicators are ideal for measuring and controlling a wide variety of process variables. The display can be easily scaled via the front panel to virtually any engineering unit.

Two optional 5 Amp Relays include programming features for Hysteresis, Time Delay, and Relay operation. These features allow for programmable deadband and alleviate relay chatter. Optional Analog or Digital outputs are available for use with chart recorders or computers. Other programmable software features include programmable decimal point and a password

lockout feature. By using the Password feature, the meter's programming functions and setpoints are protected from accidental re-programming.

Hawk Series Controllers / Indicators are compactly designed for applications requiring minimal rear panel depth and feature a standard 1/8 DIN case made of high impact Noryl® plastic. The Hawk has an optional Nema 4 rated front panel cover which equips the unit for washdown environments. A two piece screw terminal is standard for easy installation and removal of the meter.

Installation and Panel Cutout



Mounting Instructions

Insert the instrument into the panel and fasten it with the two sliding rails and brackets provided.

Engineering Label Placement

To replace the engineering unit label, insert a screwdriver into the lateral slot in the front panel and gently twist the screwdriver. Remove the front panel completely, and replace the engineering unit label with tweezers. Snap the front panel on after label is replaced.

Specifications

DISPLAY

Type: 7 segment, red LED.

Height: 0.56" (14.2 mm).

Decimal Point: Programmable.

Overrange: When the input signal exceeds the upper limit for the span, with a value within 5% of the span (Hi-Lo), the upper limit (Hi) flashes. Beyond this point, the display will flash "EEE".

Underrange: When the input signal falls below the lower limit for the span, with a value within 5% of the span (Hi-Lo), the lower limit (Lo) flashes. Beyond this point, the display will flash "-EEE".

Alarm Indicators: Two LED indicators

POWER REQUIREMENTS

AC Voltages: 24, 48, 110, 220 VAC, $\pm 15\%$

DC Voltages: 9-32 VDC (max. 3.5 amp draw on start-up)

Power Consumption: 9 VA max.

ACCURACY:

RTD Pt 100: $\pm 0.1\%$ of input ± 1 digit

0.1°C/°F resolution (-100 to +200°C/-148 to 391.8°F)

1.0°C/°F resolution (-200 to +850°C/-328 to +1562°F)

RTD Ni 100: $\pm 0.15\%$ of input ± 1 digit
(-60 to +180°C/-76 to +356°F)

J: $\pm 0.2\%$ of input ± 1 digit

(-200 to +750°C/-328 to +1382°F)

K: $\pm 0.2\%$ of input ± 1 digit

(-100 to +1250°C/-148 to +2282°F)

R: $\pm 0.1\%$ of input ± 1 digit

(+350 to +1600°C/+662 to +2912°F)

S: $\pm 0.1\%$ of input ± 1 digit

(+350 to +1750°C/+662 to +3182°F)

ENVIRONMENTAL

Operating Temp.: 0°C to +50 °C

Storage Temp.: -10 °C to +60 °C

Relative Humidity: <90% non-condensing

Ambient Temperature: 25°C

Temp Coefficient (per °C/°F):

HK 35: ± 150 ppm/°C (RTD), ± 200 ppm/°F (TC)

HK 45: ± 80 ppm/°C (RTD), ± 110 ppm/°F (TC)

Warmup Time: 15 minutes

NOISE REJECTION

NMRR: 60 dB @ 50/60 Hz

CMRR: 90 dB (1 K Ω unbalanced) @50/60 Hz

ANALOG TO DIGITAL CONVERSION

Technique: Special Dual Slope

Rate: **HK 35:** 4 samples per second, nominal

HK 45: 4 samples per second, nominal

MECHANICAL

Bezel: 3.8" x 1.9" x .21"

(96mm x 48mm x 5.5 mm)

Depth: 5.35" (136mm)

Panel Cutout: 3.6" x 1.8" (92mm x 45mm)

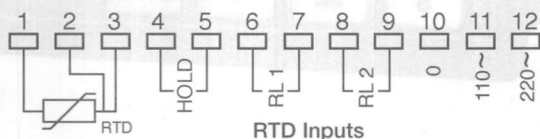
Case Material: 94 V-1 UL rated Noryl®

Weight: 16 oz. (453.6 g)

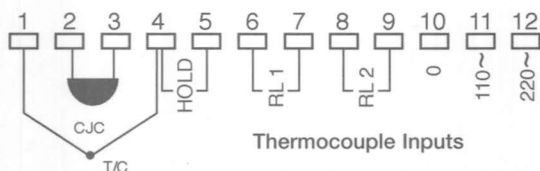
INPUT: Temperature

Input Range	Resolution		Exception
	HK 35	HK 45	
J	1.0°C	1.0°F	RTD Pt 100
K	1.0°C	1.0°F	(#141/#143)
R	1.0°C	1.0°F	have 0.1°C
S	1.0°C	1.0°F	/0.1°F resolution.
RTD Pt 100	1.0°C	1.0°F	
RTD Ni 100	1.0°C	1.0°F	

Wiring Diagram



RTD Inputs



Thermocouple Inputs

Input Signal:

Connect the input signal to terminals per the diagrams shown to the left.

Supply Power:

110 VAC & 24 VAC are connected to terminals #10 and #11.

220 VAC & 48 VAC are connected to terminals #10 and #12.

9-32 VDC is connected to terminals #10(-) and #11(+).

Display Hold:

This is a standard feature on the Hawk Controller. The display value can be held indefinitely by shorting terminals #4 and #5. The comparison of the input variable with the alarm set point remains active. This allows the controller to function normally when the display is held. To re-activate the display, remove the short between the two terminals.

Programming

The Programming mode allows the user to define the following instrument parameters:

- Password for access to programming
- Decimal point position
- Minimum and maximum values of the electrical range
- Display scaling
- Alarm Set point values

The normal measurement and control functions are not active during programming mode. **The input variable is not monitored during the programming sequence.** The operator can exit the programming mode at any time by pressing the "S" key. Termination for the programming mode is automatic after the last variable is entered. The Hawk will return to the measurement and control mode after the programming mode is exited or if 45 seconds has passed between pressing keys.

In this section, the programming references the 3-1/2 digit unit. If you are using a 4-1/2 digit unit, simply add another digit to the references made herein. During the programming sequence, the "PV" LED will flash to indicate you are in the programming mode.

Access to Programming (PAS)

Press the "S" key. The display will show "PAS" for about 1 second. The $\blacktriangle$ and $\blacktriangledown$ keys affect the displayed value up or down. The correct password must be displayed, then press the "ENTER" key. The unit is shipped with a password of "0".

Programming a new password

If the correct password is entered, the "PV", "SP1", and "SP2" LED's will flash. The display will show "PAS" for 1 second, and then the password will be displayed again.

To retain the password, press "ENTER" to pass to the next parameter. To change the password, press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired password is displayed. Then press the "ENTER" key to proceed to the next parameter.

Decimal Point Selection (dp)

The display will show "dP" for 1 second. The display will then show "1111" and the "PV" LED will be flashing. The current decimal point position will be displayed. To change the position of the decimal point, press the $\blacktriangle$ or $\blacktriangledown$ key to move it left or right, respectively. Press the "ENTER" key to pass to the next parameter.

Electrical Input Range (LoE and HiE)

The input range must be specified. The display will indicate "LoE" for 1 second, then the stored value will be displayed.

To retain the stored value, press "ENTER". To increase or decrease the "LoE", press the $\blacktriangle$ or $\blacktriangledown$ keys until the desired value is displayed. This value should be the lower end of the thermocouple or RTD range. For example, a Type J Thermocouple has a LoE of -328°F. Press "ENTER" to lock in the "LoE" value.

"HiE" will appear for 1 second, then the stored value will be displayed. To retain this value, press "ENTER". This is the high end value of the thermocouple or RTD. A Type J Thermocouple has a

Programming cont.

HiE of 1382°F. To modify the 'HiE' value, use the ▲ and ▼ keys. Press "ENTER" to lock in the new value.

Display Scaling (Lo/Hi)

The display can be scaled to any engineering unit. This allows the unit to easily display values different from the input. For example: Electrical Input Range : -328° to 1382° (LoE to HiE)
Programmed Display Scaling: 0 to 100% (Lo to Hi)

The link between the input value and the displayed value is completely adjustable. Thus, it is possible to correlate a minimum input value to a maximum displayed value. This is called "scale inversion".

The Display will show "Lo" for 1 second. This is the minimum displayed value corresponding to the input range. Commonly in temperature applications Lo is the same value as LoE. The stored value will be displayed. To retain the stored value, press "ENTER". To modify the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to lock in this new value and pass to the next parameter.

The Display will show "Hi" for 1 second, then the stored value will be displayed. Commonly in temperature applications, Hi is the same value as HiE. This value can be changed up or down by using the ▲ and ▼ keys. By changing the high value, the input is scaled to display a new range. Press "ENTER" to pass to the next parameter.

Programming the Set points

The Hawk is shipped with two programmable set points for the alarm LED's on the front panel. Relays can be optionally added to the unit, and will work based on the parameters programmed to the set points. These relays can be used to turn on a light or process. The set point is relative to the span (defined by "Lo" and "Hi"), not the electrical input range. The set points can be displayed during normal operation by pressing the ▲ or ▼ key. The "SP1" LED will turn on, and the display will show set point #1. Press the ▲ key again, "SP1" will turn off and "SP2" will turn on, and set point #2 will be displayed. The display will stay on for 10 seconds, then revert to normal operation.

Alarm Set Point #1 (SP)

The display will show "SP" for 1 second. The "SP1" LED will flash while you are programming the "SP1" values, and the "PV" LED will stop flashing. The stored set point value is displayed, and can be

changed up or down by using the ▲ or ▼ keys. Press "ENTER" to lock in the value and to pass to the next parameter.

High and Low Alarm Level (uP/do)

The display will indicate "uP" or "do" signifying high or low alarm level. Use the ▲ and ▼ keys to change the state. Press the "ENTER" key to pass to the next parameter.

Hysteresis (HYS)

"HYS" will be displayed for 1 second. Hysteresis is the difference between the set point value (at which the alarm is enabled) and the value at which we want to disable the alarm.

Hysteresis is selectable from 0% to 100.0% of the maximum display span. Use the ▲ and ▼ keys to affect the value displayed, and press "ENTER" to lock in the new Hysteresis value.

Time Delay (dEL)

The Time Delay is programmable for 0 to 99 seconds. Time delay differs from Hysteresis, because this value indicates how long the Hawk will wait after reaching an alarm state before turning on the "AL1" LED (and triggering the relays, if installed).

The Hawk will display "dEL" for 1 second, and then display the stored value. To change the value, use the ▲ and ▼ keys to increase or decrease the value. Press "ENTER" to store the new value in memory.

Relay Status (nd/nE)

This is the relay status in the absence of an alarm condition. The instrument will display the stored value, which can be changed by pressing the ▲ or ▼ key. ▲ will make the status "nE", while the ▼ key will make the status "nd".

Set Point #2

If the unit is equipped with 2 relays, the programming sequence will continue. The "SP1" LED will turn off, and the "SP2" LED will turn on, and the Hawk will proceed through the programming sequence for the second set point.

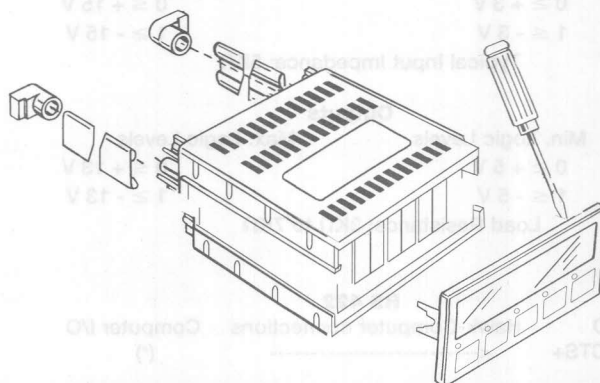
Exiting Programming mode

After programming the relay(s), the Hawk automatically exits the programming mode. The "SP1" LED (or "SP2" if you have 2 relays) is turned off, and the "PV" LED will start flashing. The display will show "run" for about 1 second, then the unit will function normally. The programming mode can be exited at any time by pressing the "S" key.

Disassembling the Hawk

Normally the Hawk should not be opened as there are few user serviceable parts inside, and there are few user modifiable options inside the unit. Most variables and parameters are programmed through the front buttons via the Programming mode. However, if you need to open the unit to move a jumper (to change an Excitation range or Peak Hold function), remove the screws, side retainers, and mounting brackets first. Use a small screwdriver, and gently pop the bezel off of the posts holding it onto the case.

Remove the clamping "O" rings from the rear posts, and slide the top shell off from the bottom shell. This will expose the components of the Hawk, allowing you to make the necessary adjustments to the unit. After you are finished, put the top shell back on the unit, and carefully replace the clamping "O" rings on the back and the bezel on the front.

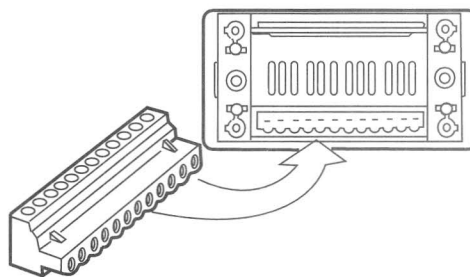


2 piece Connector

A special 2 piece connector is standard on the Hawk Controller. This allows the unit to be easily removed from the wiring connections without the need to un-solder the signal input wires. Wiring up this light weight connector is easier than holding a meter up and trying to solder wire to an edge connector.

First, attach the input signal and power supply to the screw terminal connector provided with the unit.

The screw terminal connector is attached to the mating connector on the back of the Hawk unit (see the diagram). Install the meter into your panel, and it is ready to be powered up.



Digital Outputs

There are 5 digital outputs available for the Hawk:

- 1) RS232C (serial)
- 2) RS422 (serial)
- 3) BCD Open Collector (parallel)
- 4) BCD Open Collector w/ selection lines (parallel)
- 5) BCD Tri-State output (parallel)

Serial Outputs

RS232C and RS422 are serial interfaces suitable for connecting the Hawk to personal computers, host computers, or printers. The communications mode is asynchronous and mono-directional. This means that it is not possible to change the programming parameters of the Hawk directly from the computer. The data exchanged between the Hawk and the computer complies with ASCII standards. The connection for RS232C must use a 5-wire shielded cable (max. length is 15m / 49 ft). The RS422 connection must use a 9-wire shielded cable (max. length is 1200m / 3937 ft). These connections are made to the upper connector on the rear of the Hawk. See the charts below for the pin connection call-outs, and the diagram after the charts for the terminal locations on the rear of the Hawk.

Specifications:

Baud Rate: 1200, 4800, 9600, 19200.

Format:

Data Bits: 7 or 8

Parity: Even, odd or none

Stop Bits: 1 or 2

RS232C		
Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS	-----	(*)
Pin 2A RTS	-----	(*)
Pin 3A TX	-----	RX
Pin 4A RX	-----	TX
Pin 5A SG	-----	SG

Inputs	
Min. Logic Levels	Max. Logic Levels
$0 \geq +3\text{ V}$	$0 \leq +15\text{ V}$
$1 \leq -3\text{ V}$	$1 \geq -15\text{ V}$

Typical Input Impedance: 5K Ω

Outputs	
Min. Logic Levels	Max. Logic Levels
$0 \geq +5\text{ V}$	$0 \leq +13\text{ V}$
$1 \leq -5\text{ V}$	$1 \geq -13\text{ V}$

Load Resistance: 3K Ω to 7K Ω

RS 422		
Hawk I/O	Hawk-Computer connections	Computer I/O
Pin 1A CTS+	<-----	(*)

Pin 2A RTS+	----->	(*)
Pin 3A TX+	----->	RX+
Pin 4A RX+	<-----	TX+
Pin 1B CTS-	<-----	(*)
Pin 2B RTS-	----->	(*)
Pin 3B TX-	----->	RX-
Pin 4B RX-	<-----	TX-
Pin 5B SG	<----->	SG

Inputs

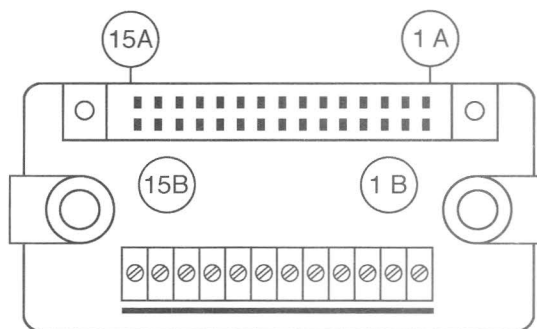
Min. Logic Levels	Max. Logic Levels
$0 \geq +0.2\text{ V (diff)}$	$0 \leq +12\text{ V (diff)}$
$1 \leq -0.2\text{ V (diff)}$	$1 \geq -12\text{ V (diff)}$

Outputs

Min. Logic Levels	Max. Logic Levels
$0 \geq +1.5\text{ V (diff)}$	$0 \leq +5\text{ V (diff)}$
$1 \leq -1.5\text{ V (diff)}$	$1 \geq -5\text{ V (diff)}$

Termination Resistances : 100 $\Omega \pm 10\%$

(*) Control lines managed by the software, so as to enable the correct reception of the data transmitted from the Hawk.



CTS = Clear to send (computer ready to receive data)
 RTS = Request to send (Hawk ready to transmit data)
 TX = Transmit data (data transmission from Hawk)
 RX = Receive data (data reception from computer)
 SG = Signal Ground

Note: The inactive lines are in the high logical status. All inputs/outputs are protected from short-circuits. The serial output is isolated from the input variable signal (500 VRMS) by means of optocouplers. This applies to both the RS232C and RS422. If you do not have a program, or do not want to write one, a program is available from Simpson, written in BASIC. Please call or write to Simpson Electric Company for current price and delivery.

Simpson Electric Company
 853 Dundee Ave.
 Elgin, IL 60120
 (708) - 697 - 2260

Digital Outputs cont.

BCD Outputs

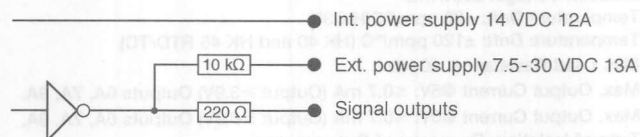
There are three kinds of BCD outputs available for the Hawk. On the three variants, the signal outputs are protected from short-circuits, and isolated from the input variable signal (500 VRMS) by means of optocouplers.

BCD Open Collector output signal

The connections for this output signal are to rows A and B of the upper rear edge connector on the Hawk. All outputs are open collector types, and the Voltage level relating to 0 is ≤ 1.2 Volts. The power supply for open collector outputs is applied to pin 13A. It can vary from 7.5 VDC to 30 VDC. With this function it is possible to use the internal supply voltage (14 VDC) by creating a jumper across pin 12A with pin 13A. This Voltage will not be stabilized, and it can drop to 7.5 VDC. See the chart immediately below for all the appropriate pin call-outs, and the diagram below the chart for the resistance values of the External power supply and Signal Outputs.

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	



IOFF(Max) = 250 μ A @45°C

ION (Max) = 10 mA

Digital Signal Outputs

1st digit(1sd)	2nd digit	3rd digit	4th digit
Value Pin	Value Pin	Value Pin	Value Pin
1 1B	10 1A	100 5B	1,000 9B
2 2B	20 2A	200 6B	*2,000 10B
4 3B	40 3A	400 7B	*4,000 11B
8 4B	80 4A	800 8B	*8,000 12B

* These signals are present only for the HK45.

BCD Open Collector w/ Selection lines

This output is very similar to the other BCD Open Collector output except for the enable commands. The Digital Signal Output chart does not change, but the auxiliary signals chart changes as follows:

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Internal Power supply V+	12 A	
Ext. Open Coll. Pow. Supply	13 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The power supply is connected the same way with the same features. In addition, the digital signal outputs chart is exactly the same as the first BCD option. The only real changes are the addition of Enable commands.

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus from 22 to 13. This is done by connecting (in parallel) the outputs of Digit 1 and 2 with the outputs of Digit 3 and 4, and with the outputs of Burn-out, Underrange, Overrange, and Sign. Each data group can be selected by means of 3 'Enable' lines and the ground line. It is possible to use all output lines (without data group selection) by connecting the 3 enable commands to ground.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

BCD Tri-State Output signal

Like the other BCD options, the output signals are connected to the upper rear connector on the Hawk. The main difference is that these outputs are CMOS type outputs. The Voltage level relating to 0 is ≤ 1 V; relating to 1 ≥ 3.5 V. The Digital Signal Outputs are connected to the same terminals as the other two types of BCD outputs (see the chart to the left).

Auxiliary Signals

Function	Pin	
Burn-out	6 A	
Overrange	7 A	
Sign(*)	8 A	(*) Negative = logical status 1 Positive = logical status 0
Underrange	9 A	
Ground	10 A	
Enable 1	13B	
Enable 2	14B	
Enable 3	15B	

The Enable commands (active low) allow you to select the group of data outputs indicated in the Digital Signal Output table below.

Command	Data Group
Enable 1	Digit 1 and 2
Enable 2	Digit 3 and 4
Enable 3	Burn-out, Under/Overrange, Sign, 5th digit(*) (*) Only for the HK 45

It is possible to reduce the number of lines of the parallel bus for the BCD Tri-State outputs. This is done in the same manner as the BCD Open Collector Output Signal with Selection Lines.

It is also possible to connect more than one instrument to an acquisition unit by means of a common bus. The connection between instrument and acquisition logic must be carried out by means of a shielded cable (max. length 5m / 16ft, max. capacity 100pF/m).

For information on connecting the Hawk to a printer or host computer, please call the factory. We have additional information we can fax or mail to you upon request.

Analog Outputs

There are 5 different Analog output signals available in the Hawk:

- 1) 4-20 mADC
- 2) 0-1 VDC
- 3) 0-10 VDC
- 4) 1 mVDC / digit (HK 35, HK40, HK45 RTD/TC)

The Analog outputs are protected from short circuits (except the 4-20 mA). All of the connections referenced on the following chart are for the upper edge connector on the rear of the Hawk controller. Please note that pin 1A is on the extreme right, and 15A is on the extreme left. Also, when a Burn-out, Overrange, or Underrange condition occurs (on the outputs relating to 6A, 7A, or 9A), a signal of 5 VDC is available. If none of these conditions occur, the signal is 0 VDC (typical values).

The following table shows the logic outputs for all the Analog output variations for Temperature controllers.

Pin #	Logic Output
6A	N/A
7A	Overrange
8A	Sign (steady at 0)
9A	Underrange
10 A	Ground

The following table indicates the terminal points where the output signal emanates from.

Analog Output	Out +	Out -
4-20 mADC	Pin 13 A	Pin 14 A
0-1 VDC	Pin 12 A	Pin 11 A
0-10 VDC	Pin 12 A	Pin 11 A
1 mVDC/digit	Pin 12 A	Pin 11 A

The diagram to the right shows the upper and lower terminals for connections.

The following tables show the relationship between the output signal and the displayed value.

4-20 mADC:

$$I = (16/Hi-Lo) \times (RDG-Lo) + 4$$

I = Output Current (mA)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.25\%$ of input ± 0.01 mA @25°C

Temperature Drift: ± 120 ppm/°C

Max. Load Resistance: 400 Ω Isolation Voltage: 500V rms

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

0-1 VDC and 0-10 VDC:

$$V = (RDG - Lo) / (Hi - Lo)$$

V = Output Voltage (V)

Hi = Max. programmed value of the whole measuring range

Lo = Min. programmed value of the whole measuring range

RDG = Displayed Value

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Temperature Drift: ± 80 ppm/°C

Min. Load Resistance: 10 K Ω Output Resistance: $\leq 3\Omega$

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

Isolation Voltage: 500V rms (between PV and OUTPUT)

1 mVDC / digit:

$$mV = RDG \times (\text{number of digits})$$

mV = Output Voltage (mV)

RDG = Displayed Value

For example, if the displayed value corresponds to 100.0%, the output voltage is 1000 mV (1 V).

Accuracy: $\pm 0.20\%$ of input ± 0.01 V @25°C

Isolation Voltage: 500V rms

Temperature Drift: ± 80 ppm/°C(HK 35)

Temperature Drift: ± 120 ppm/°C (HK 40 and HK 45 RTD/TC)

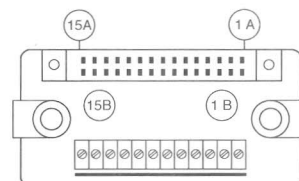
Min. Load Resistance: 10 K Ω

Max. Output Current @5V: ≤ 0.7 mA (Output ≥ 3.9 V) Outputs 6A, 7A, 9A.

Max. Output Current @0V: ≤ 0.7 mA (Output ≤ 0.8 V) Outputs 6A, 7A, 9A.

Type of Isolation: By means of Optocouplers

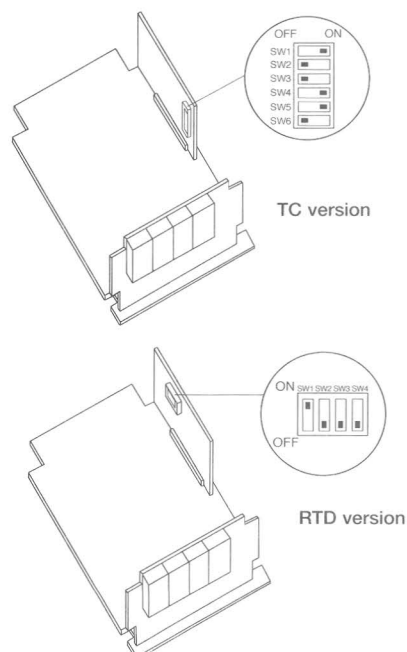
The signal outputs are protected from short circuits.



Burn out, Over/Underrange

Burn-Out. The Burn-out indication (EEE or -EEE) appears when one of the following conditions occurs: Interruption for both kinds of probes (TC or RTD), or short circuit for RTD probes. The display will show EEE if up-scale burn-out is selected. If down-scale burn-out is selected (this is standard configuration when shipped from the factory), the display will show -EEE if there is an interruption in the probe. An interruption could be a broken probe, or the probe has come undone from the meter.

The burn-out selection can be changed from down-scale to up-scale by means of DIP switches on the TC/RTD card inside the meter. To select up-scale, set SW1 to ON for TC models, or SW4 to the OFF position for RTD inputs. Do not change any other DIP switch. This will change the measurement range and the unit will require calibration. The diagram below shows the location of the TC/RTD card on the main board.



Relays

Optional relays are available with the Hawk. The relays are 5 amp, 250 VAC, DPST models. Up to 2 relays can be installed in the Hawk II controller. The relays are programmed through the software in the Hawk to be Normally Energized or Normally De-Energized, and are activated (or de-activated) based on the set points. Hysteresis for the relays is easily programmed in the Hawk to eliminate "chatter" in the relays. The Hawk has a Time Delay adjustment of 0 to 99 seconds for the set points.

The relays are set up during the programming sequence. The values for the Alarm Levels corresponds to the relay values. When an Alarm condition is met, the relay will be enabled (or disabled) and the appropriate Alarm light (AL1 or AL2) will flash. This gives the operator a visual indication that the relay has been enabled (or disabled).

Relays can be used to "turn on" or "turn off" power to a process that the Hawk is monitoring. A light can be "turned on" when a set point is exceeded, alerting the operator to a change in condition in the process. Also, the excitation or analog output of the Hawk can be controlled with the relays by wiring them together, "turning on" or "turning off" the excitation when a set point is reached or exceeded.

The set points for the relays are the same as the Alarm set points, which are specified when you program the controller. The front panel has two LED's which are used to indicate when an Alarm condition is met, and the appropriate relay is activated.

The unit is delivered with normally closed contacts (NC) for the alarm relays. If you would prefer the contacts to be normally open during operation, they can be modified in the programming sequence.

By changing the values of the Alarm status and the Relay status, the controller will act as though the contacts had been changed, without actually changing them.

The chart to the right shows the Alarm and Relay conditions when the configuration is changed.

RELAY SPECIFICATIONS

Breakdown Voltage:

750 VRMS (60 Hz) across contact gap,

4,000 VRMS (60 Hz) between coil and contacts.

EXPECTED LIFE

Mechanical: 20 million operations minimum.

Electrical: 100,000 operations minimum.

Temperature range: -40° C to 70° C.

TIME VALUES

Pull in time: 8 mS maximum.

Drop out time: 4 mS maximum.

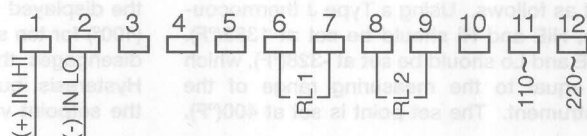
CONTACTS

Ratings: 5 A @ 250 VAC.

Material: Ag - Cdo.

Arrangements: 1 Form C.

The following diagram shows the location where the relays are wired to the connector. Relay #1 is wired from terminals # 6 and #7, and relay #2 is wired from terminals #8 and #9.



Programmed Values		When Above Set point		When Below Set point	
Alarm	Relay	Alarm	Relay	Alarm	Relay
UP	NE	On	Closed	Off	Open
UP	ND	On	Open	Off	Closed
DOWN	NE	Off	Open	On	Closed
DOWN	ND	Off	Closed	On	Open

For example, a customer wants to turn on a heater and Alarm light #1 when the temperature is below 60°, and turn on Alarm light #2 when the temperature is above 85°.

Set point #1 should be set at 60, Alarm #1 set at "DOWN", and the relay set at "NE".

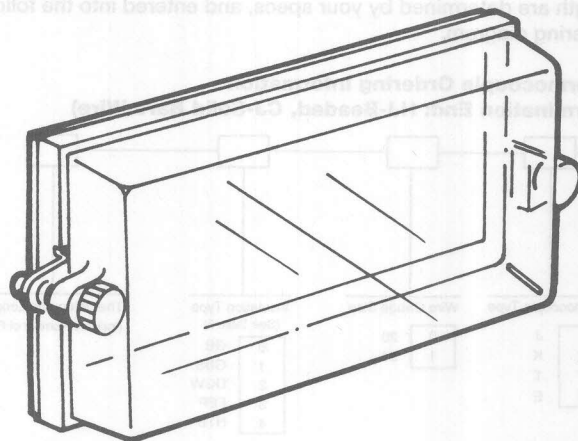
Set point #2 should be set at 85, Alarm #2 set at "UP", and the relay set at "NE".

NEMA 4 Cover

An optional NEMA 4 cover is available for use with all Hawk series controllers. This cover will help protect the controller in washdown environments where water and dust are present. The cover has two gaskets, and is attached to the panel where the meter will be mounted.

This optional cover can be removed from the panel, exposing the meter front by using the two screws on the left and right of the cover. The bezel of the Hawk is exposed, and the programming buttons can be accessed. This allows quick display scaling and decimal point selection without having to remove the meter from the panel.

To install the cover, slide the meter through the back half of the cover. Install the meter in the panel, and then screw the front half of the cover over the meter.



Application Example

A baking company needs an on-off controller for the baking ovens. A relay is needed to maintain the temperature around 400°. There is a need for a 4-20 mA signal to be sent out to a chart recorder, which will document the oven temperature during the day.

A Hawk temperature unit with 4-20 mA output and a single relay can fill the application need.

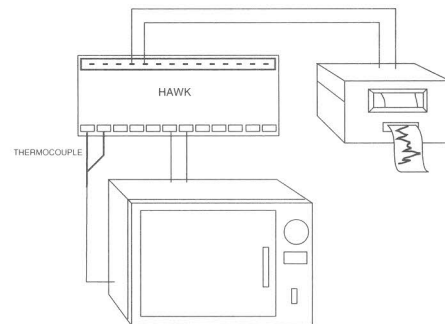
The Type J Thermocouple is installed inside the oven, allowing it to monitor the temperature inside. The relay is installed in the oven power controls. This allows the relay to turn on and off the oven. The relay is controlled by the set point which is programmed into the Hawk.

The programming of the Hawk should be set as follows. Using a Type J thermocouple, HiE and Hi should be set at 1382(°F). LoE and Lo should be set at -328(°F), which is equal to the measuring range of the instrument. The set point is set at 400(°F).

By setting the relay status to "do" (down), the relay will be de-energized below 400°. When the temperature rises above the setpoint, the relay will open, interrupting the power to the oven. When the temperature falls below 400° again, the relay will de-energize, allowing it to begin heating up again. If the relay breaks or is blown, the oven will turn off and cool down, because the relay will not be able to complete the loop which powers the oven.

The Hysteresis set at 1.0 in the programming mode. The controller will allow the displayed value to fall below the setpoint level by an additional 1% before engaging the relay. This helps eliminate chatter in the relay if the displayed value bounces around the set point value.

Time Delay is set at 10 (seconds), allowing the displayed value to exceed the setpoint (400°) for ten seconds before the controller disengages the relay. This is similar to Hysteresis, but works on the high side of the setpoint value. If the displayed value



falls below the set point, the Time delay begins counting over again when the value exceeds the set point.

The analog output signal is wired to the chart recorder. This gives a linear signal (based on the displayed value) to the recorder. The recorder then charts the "temperature" over the course of the day, allowing the plant to monitor the internal baking temperature of the oven.

Ordering Information

Power Supply		Peak Hold		Output Signal		Relays	
1	110/220 VAC	0	None	0	None	0	None
2	24/48 VAC			1	4-20 mA	1	One
3	9-32 VDC			2	0-1 V	2	Two
Basic unit		Range		Excitation			
HK 35	3-1/2 digit	141	RTD Pt 100	3	1 mV/digit		
HK 45	4-1/2 digit	142	-100 to 200°C, HK35	4	NA		
		143	-200 to 850°C, HK35	5	RS 232C		
		144	-148 to 391.8°F, HK45	6	RS 422		
			RTD Ni 100	7	BCD Open Col.		
				8	BCD TRI-STATE		
				9	BCD O.C. W/		
				A	SEL. LINES		
					0-10 V		
		151	-60 to 180°C, HK35				
		152	-76 to 356°F, HK45				
NEMA 4 Cover : Catalog # 45003							

Safety Symbols

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the instrument.

Thermocouple Accessories

Simpson thermocouples are available in custom lengths per your application. Calibration type, wire gauge, insulation type, and length are determined by your specs, and entered into the following ordering diagram.

Thermocouple Ordering Information

(Termination End: HJ-Beaded, CJ-Solid Bare Wire)

TH				
Thermocouple Type	Wire Gauge Size	Insulation Type (See Table 5)	Thermocouple Length (Indicate Number of Feet)	
J K T E	0 20 1 24	0 GB 1 GBS 2 DGW 3 FEP 4 HTB		

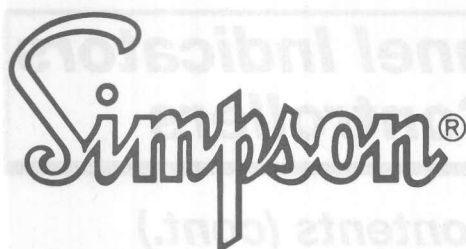
THERMOCOUPLE PROBES (QUICK DISCONNECT)

Simpson offers "Quick Disconnect" style thermocouples which include a probe and an ANSI color coded jack and plug. Each 12 inch thermocouple probe is compacted with MgO insulation, with 316 stainless steel and 0.188 inch diameter outer sheath. Extra plugs and jacks are sold separately. See the table below for ordering information.

THERMOCOUPLE PROBES (48 INCH LEAD WIRE)

Simpson's transition joint thermocouple probes are constructed with MgO insulation. The probe includes 48" of Teflon® coated thermocouple wire and stripped leads.

Type	Catalog Numbers				
	ANSI Color Code	Quick Disconnect	48 Inch Lead Wire	Plug Only	Jack Only
J	Black	21238	21242	21245	21249
K	Yellow	21239	21243	21246	21250
T	Blue	21240	-----	21247	21251
E	Purple	21241	-----	21248	21252
RTD	-----	-----	21244	-----	-----



Analog Panel Indicators and Controllers

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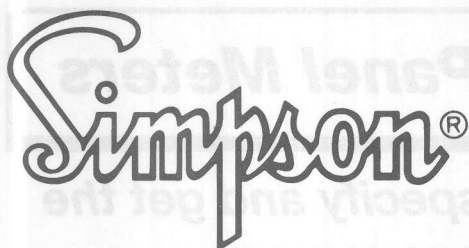
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Analog Panel Meters

How to specify and get the most for your money

Initial Considerations

Since more than one third of the panel meters manufactured are made to designer's specifications, wise selection of meters should involve more than mere catalog prowling and pricing. There are many aspects of meter construction, operation and use that the knowing design engineer can use to get the best meter for a given application.

When specifying panel meters, first consider the engineering of the instrument and the solutions the manufacturer offers for special problems. Second, check for construction methods that influence reliability and service life (i.e., the type of materials used, guaranteed tolerances, type of movement, special deflection characteristics, and dependable antistatic treatment).

Attention to these details should not only insure the best meter at minimum cost, but also can provide additional features at little or no extra cost. In evaluating meters, please consider the following points below.

Construction

Construction methods and assembly conditions can spell the difference between a dependable meter and one that becomes a problem. Calibration shift is one of the serious problems that can be overcome by proper design and construction techniques. Typical approaches to provide the desired stability are the use of full bridge construction in the movement design and thermal cycling of the assembled meter to "set" any potential stress relief shifting of parts. In full bridge construction (Figure #1), both the top and bottom bridges that secure the entire movement are anchored at both sides.

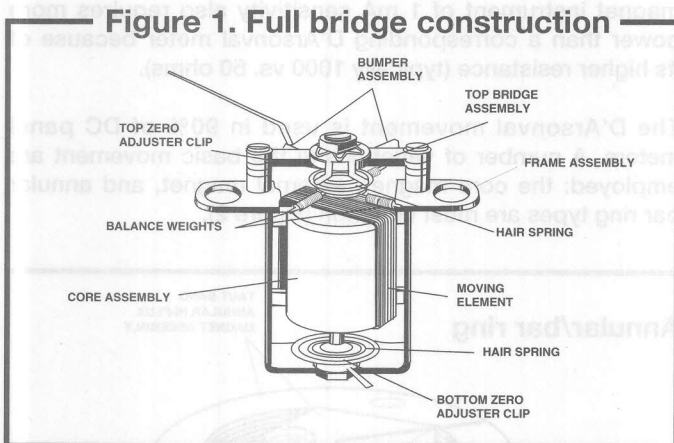


Figure 1. Full bridge construction

This construction gives the high rigidity that the movement requires to withstand shock and maintain jewel alignment. In other movement types, one or both bridges are held at only one point with a cantilevered support and are subject to shift. Temperature changes or stress relieving of the can-

tilever can cause it to warp and shift the entire assembly. This shifts the coil in relation to the magnetic field and changes calibration. Such warping can also change the jewel and play and result in either a "sticky" movement or one that "flops" as its position is changed. Full bridge construction is a must in high quality meters.

Another factor contributing to calibration stability is "aging," an artificial process of subjecting a magnet to a demagnetizing field that diminishes its strength from an original peak to a relatively stable state. Even after three years of use, nearby currents as high as 100 to 200 amps will have virtually no effect on an aged magnet; perhaps from 0.1 to 0.2%. On an improperly aged magnet, a magnetic field set up by nearby currents can change magnet strengths, thus changing meter calibration.

Unit Measurement

The designer's first step is to specify the unit to be measured and whether the frequency range is DC, AC or RF. VU meters and audio level (db) meters are simply AC voltmeters of the rectifier type with appropriate range, impedance and ballistic characteristics. These types can be specified easily by most design engineers.

Wattmeters and ohmmeters, however, are special breeds of meters, which few designers should select without first consulting the meter manufacturer.

Range

Selecting end scale values to be displayed by the meter is the next step. Many designers overlook the values of the suppressed zero meter, in which the significant portion of the range is expanded to occupy the entire scale. Accuracies may be increased in proportion to the scale expansion. A meter with an accuracy of 2% of full scale can have a maximum error of 2 V if the range is 0-100 V and a maximum error of only 1 V if the range is 50-100 V.

Sensitivity

Sensitivity is the excitation required for end scale deflection. It can be expressed in wattage, resistance, voltage, volt amperes, impedance or current. For maximum accuracy, standard DC meters up to 4-1/2 inches in size require 10 to 50 mV, depending on the range and type. As a rule, when sensitivity is increased, the cost increases.

When a greater sensitivity (less power consumption) is important, it can be obtained by using a more efficient movement (at greater cost) or by compromise in other meter characteristics.

Increased sensitivities corresponding to full range power requirements of only 1 to 2 microwatts are possible without



Analog Panel Meters

How to specify and get the most for your money

appreciable increase in cost of standard DC meters of 2% accuracy.

Accuracy

Accuracy is the measure of a meter's ability to indicate the absolute value of electrical energy applied at 77°F in a standard mounting position. Changes in operating position can cause slight changes in the accuracy. While the meter movement is balanced, perfect balance is not attainable. Therefore, for best results, when the meter is moved into a nonstandard position, if necessary, reset the meter pointer to zero by means of the zero adjuster screw usually located on the front of the meter.

The accuracy of a meter at any given point is the difference between the indicated value (I) and the actual value (A) of energy applied, expressed as a percentage of the full scale range; (FS):

$$\frac{I - A}{FS} = \text{percent accuracy}$$

The standard accuracy tolerance for commercial instruments is $\pm 2\%$ of full scale. Although an accuracy of 0.25% or less can be achieved in a top-grade panel instrument, 0.5% is probably the most practical limit the designer can expect.

Tracking Accuracy

Tracking accuracy is the meter's ability to indicate at the scale mark being checked, when a meter is energized by the proportional value of actual end scale excitation. Tracking accuracy is expressed as a percentage of actual end scale value.

Tracking accuracy is usually within 1-1/2 times the rated full scale accuracy of the meter. The actual maximum tracking error possible is double the rated full scale accuracy. Therefore, a $\pm 2\%$ meter may have as much as a $\pm 4\%$ tracking error at a point on the scale, though most manufacturers work to a self-imposed $\pm 3\%$ tolerance. When specifying meters for equipment with a calibration adjustment, you can benefit by specifying tracking accuracy instead of a full scale accuracy.

If you specify a $\pm 1\%$ tracking accuracy, you can get a meter with this characteristic at a cost no higher than that of a meter with a $\pm 1\%$ full scale accuracy. You would then get a 50% increase in the overall equipment accuracy at no extra cost. On the other hand, by specifying overall accuracy and tracking accuracy, you will pay 5% more for a $\pm 2\%$ meter with a $\pm 2\%$ tracking accuracy, and 10% more for a $\pm 1\%$ unit with a $\pm 1\%$ tracking accuracy.

Temperature Compensation

Ambient temperature changes can spoil accuracy if provisions have not been made to compensate the meter movement for these changes. When specifying a meter, you must decide if you need temperature compensation in order for the meter to function correctly in the application. A temperature change of 10°F can cause a $\pm 0.5\%$ meter to become a $\pm 2\%$ unit, and an additional 10°F can change the accuracy from $\pm 3\%$ to $\pm 4\%$. When the temperature is expected to vary significantly from 77°F, you should specify what meter accuracy you need over the entire temperature range.

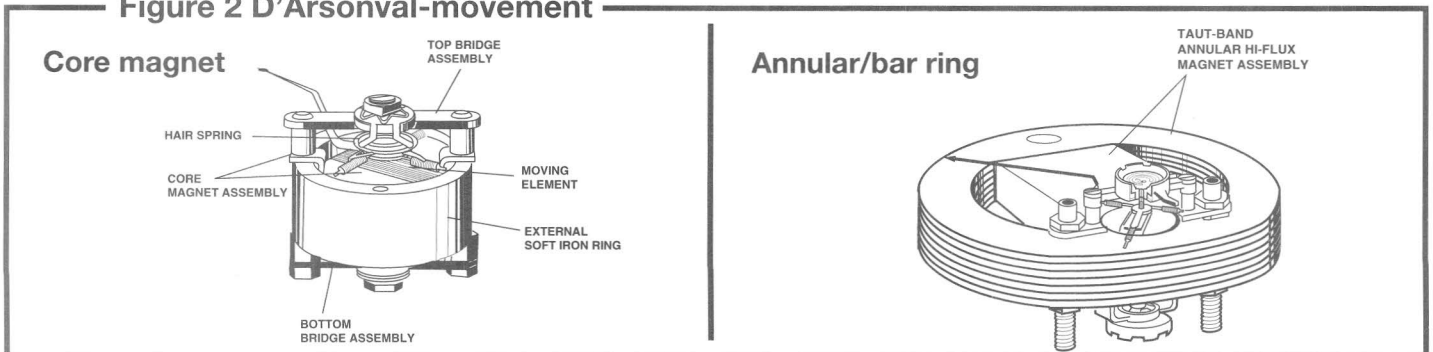
Type of Movement

DC meters commonly use either moving magnet or D'Arsonval movements. The principal advantage of the moving magnet is low cost, so it is used where low cost is essential (in automotive meters, for example).

The most serious drawbacks of the moving magnet movement are limited accuracy (no better than $\pm 5\%$, normally) and poor damping. They also have a limited total deflection angle, usually less than 70 degrees, and very limited sensitivity, normally no more than 1 mA. Although it is possible to increase sensitivity by adding wire, a substantial increase in cost would make this improvement impractical. A moving magnet instrument of 1 mA sensitivity also requires more power than a corresponding D'Arsonval meter because of its higher resistance (typically 1000 vs. 50 ohms).

The D'Arsonval movement is used in 90% of DC panel meters. A number of variations in the basic movement are employed: the core magnet, external magnet, and annular bar ring types are most common (Figure 2).

Figure 2 D'Arsonval-movement





Analog Panel Meters

How to specify and get the most for your money

Complete explanations of Simpson's many movement types are completely explained on the subsequent pages.

The chief advantage of the core type is its very small size and inherent self-shielding. It is immune to almost any external field. A 10 to 50-oersted field would not seriously affect such an instrument.

The basic design of the core type movement, however, limits its sensitivity because of its relatively small magnet size (typical flux density of less than 2000 gauss). A core type mechanism is usually not indicated for powers below 0.5 mW.

The external magnet type is probably the best known of the D'Arsonval movements. It uses a horseshoe magnet with two soft iron pole pieces to redistribute the magnetic flux throughout the air gap. The coil is located at the opening of the magnet.

The greatest drawback of the external magnet movement is its susceptibility to external fields. It cannot be mounted on a steel panel without affecting instrument calibration. A 50-oersted field will change the calibration of the unit by 5 to 10%, and may also permanently change calibration from 1/2 to 3%. The external magnet movement has fallen out of favor because it does not offer any performance advantages today.

The annular or bar ring instrument offers the most benefits with the least disadvantages of all the D'Arsonval movements. It combines the external-magnet and core type movements. The magnet and moving coil are both within a soft, iron ring which acts as a return path and a shield.

This type of movement is self-shielding and it can be used on either a magnetic or a non-magnetic panel without calibration problems. A 50-oersted field may cause a temporary 2 to 3% change in its indication, but on removal of the field, the pointer will swing back. Sensitivity of an annular movement is comparable with the external magnet type because of its longer magnet length. An annular movement with a 0.5 μ W sensitivity is practical. The annular movement is economical and offers excellent performance.

Damping Factor

Damping factor is defined as the ratio of the deviations of the pointer in two consecutive swings from the position of equilibrium, the greater deviation being divided by the lesser. The deviations are expressed in angular degrees. (The use of this term is deprecated. Use "overshoot," which is the reciprocal of the damping factor.) Damping is usually

produced by the reverse EMF (electro-motive force) set up in the coil and coil frame, due to armature motion.

An over-damped meter can be read with the least eye motion. The pointer moves directly from its rest position to its steady state position, and comes to a halt immediately. Over-damping is undesirable because there is uncertainty that the final position has been reached, and response time may be excessive.

To eliminate these problems and retain minimum eye motion, the meter can be critically damped. In a critically damped instrument, the pointer moves from the zero position to its final rest position with an extremely small overshoot (no more than half the rated accuracy). The small overshoot lets the observer know that the meter has come to final rest.

Critical damping requires extremely close control of the movement of inertia and torque of the system, period of the system, damping constant of the magnet, resistance of the frame, and damping contribution of the external circuitry. Critical damping can be costly, depending on tolerances.

Specifying within a relatively large range of damping factors can yield savings over critical damping. For example, an instrument with a damping factor between 10 to 100 can be produced for about half the cost of critical damping. Here, the overshoot will range from 1 to 10% of full scale.

When the designer specifies damping factor, he should do it on the basis of specific overshoot requirements. These requirements should be estimated realistically because when overshoot is reduced between extremely narrow limits, the unit cost increases substantially.

If the circuitry in which the meter is used will have unusually low resistance, less than 100 times meter resistance, the designer should spell out the conditions to allow the meter manufacturer to build the proper damping characteristics into the movement. Also, if a meter has a power sensitivity below 10 mW, the external resistance should be specified. If such a meter is connected into a low impedance circuit, its normal damping may be doubled or quadrupled. This consideration adds no cost to the unit, regardless of the external circuitry, and it allows the manufacturer to produce a mode-suitable meter.

Response Time

Response time is the time needed for the pointer to settle within $\pm 1\%$ of its final indication after an abrupt change in the measured quantity. The interval includes both an overshoot and undershoot of the pointer.



Analog Panel Meters

How to specify and get the most for your money

This characteristic is related to accuracy because the pointer is considered at rest when it remains within a range on either side of its final position equal to one half the accuracy rating. Typical response time is approximately 1-1/2 seconds, though smaller meters with shorter pointers usually have shorter response times. The added cost of cutting response time of a standard meter in half, assuming that such a change is feasible, will range from about 5% on smaller meters of moderate sensitivity, to 20% on large meters of high sensitivity.

Overload Protection

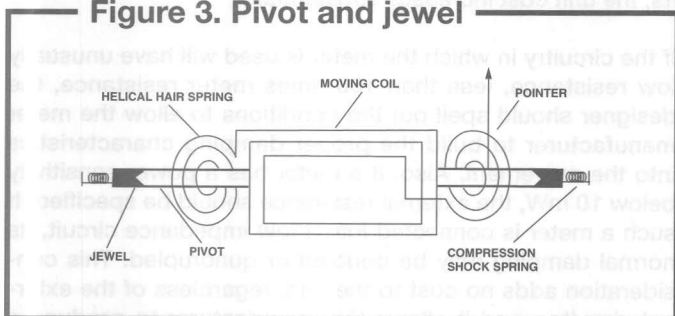
Most ammeter movements are designed for overload protection of at least 10 times the rated full scale value. For voltmeters, reasonable one second overload capacities are ten times rated F.S. for ranges up to 50V, 5 times in the 50 to 200V range, and 2 times for voltages over 200. For long term overloads up to 8 hours, the designer should not expect panel meters to carry more than 25% overload. When required, meters can be made with short time overload capacities up to several hundred times the full scale rating.

The ability to withstand overloads depends on the rigidity of the pointer, construction of the armature and the types of resistors and shunts employed, as well as the design of the protective circuitry. Inspection of the movement of a sample will give some indication of its ability to withstand overloads. On special order it is possible to provide meters with short time overload capacities ranging from several thousand times the rated full scale value.

Pivots and Jewels

When specifying pivot and jewel type meters (Figure 3), it is important to understand what type of jewel screw assemblies you are getting.

Figure 3. Pivot and jewel



Three types of jewels are used in standard meter movements: fixed jewel, cushion backed jewel, and spring backed jewel. In the fixed type jewel, there is no resilience in either the jewel or the pivot, so shock is absorbed by both elements, often damaging the jewel. The fixed type offers a slight cost advantage while sacrificing protection of the jewel. If the jewel is damaged, it can cause sticking of the

meter. This is a common problem when fixed jewel type meters are used in vibration or high shock environments.

To avoid rigid contact between the jewel elements and prevent shock damage, cushion backed and spring backed jewels are used. In these constructions, much of the shock energy is dissipated in displacing the moving member. The spring backed unit is preferable.

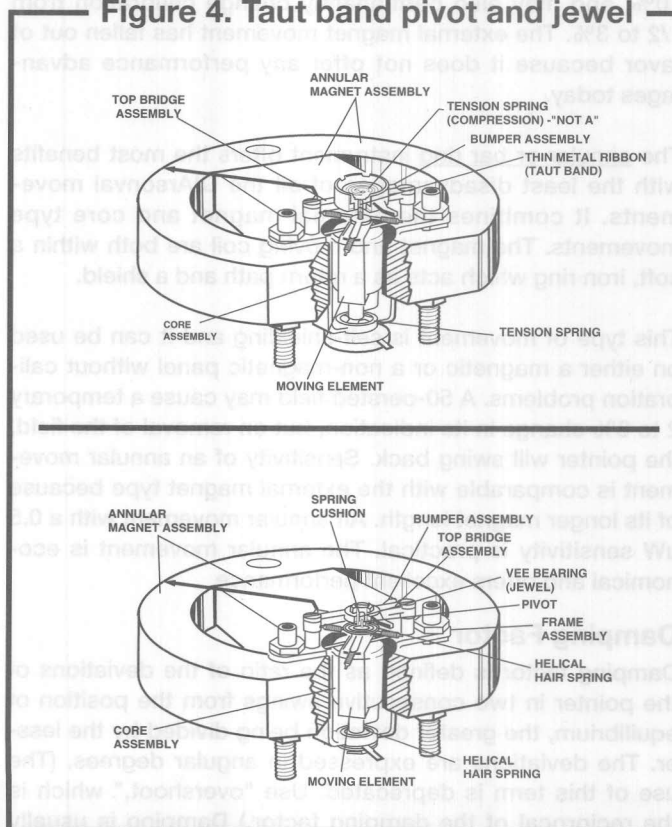
Under severe shock, the spring backed jewel deflects fully to allow the pivot base to contact the face of the retainer, dissipating the energy. The pivot and jewel are subjected to only about 20% more load than normal.

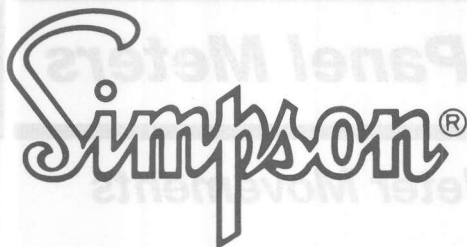
On the other hand, the cushion backed jewel is limited in its excursion and pressure builds up rapidly. Under the same conditions as the previously mentioned meter, a cushion backed unit would have an increase in pivot loading of several thousand percent. In most cases the jewel would be punctured.

Taut-Band Meters

In contrast with pivot and jewel instruments the moving element of the taut-band instrument, (Figures 4 and 5), is supported by 2 thin, metal ribbons.

Figure 4. Taut band pivot and jewel

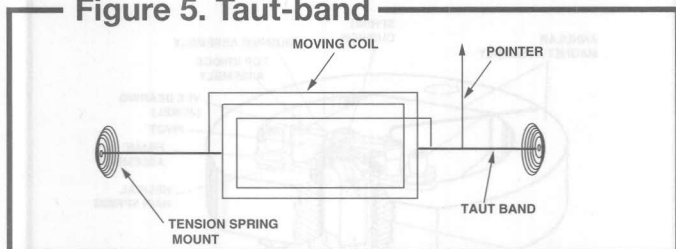




Analog Panel Meters

How to specify and get the most for your money

Figure 5. Taut-band



It is kept under tension by elastic members at each end of the assembly. This construction eliminates any physical contact between the moving parts. Thus, it does away with friction between the jewels and pivots, which would cause a slight lag of the moving element behind the actual position in a "perfect" system.

The principal advantage of the taut-band instrument is its ability to operate without appreciable repeatability error, with very limited power, less than 1 μ W. Taut-band units will withstand moderate shock or vibration, and outperform pivot and jewel instruments because they are not subject to the same gradual increase in friction. They also offer extremely long life without changing performance.

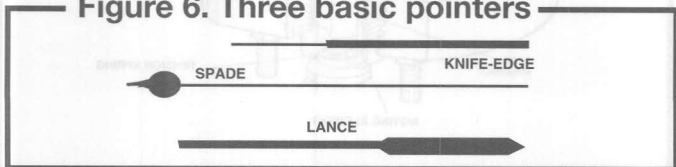
Taut-band units can withstand over 20,000,000 operations with a change in repeatability of less than $\pm 0.2\%$. This corresponds to more than 70 years of normal service. These meters are now available in sensitivities down to 5 μ A.

Taut-band movements are not without their limitations. They introduce additional resonance, so if they are subject to vibration, one or more vibration frequencies can interfere with their operation. They don't have the fast response of pivot and jewel construction, because they don't develop as much torque. A rocking vibration can whip the pointer up and down. In cases of extreme shock, the entire instrument can become inoperative, while a pivot and jewel meter may suffer increased friction but still operate. Further, the taut-band meter generally costs more than a comparable pivot and jewel type.

Pointer Types

Pointer selection (Figure 6) is important. A pointer should have adequate sturdiness for its length and type of meter operation. A standard tubular pointer is adequate for most applications. Avoid long, stamped and formed, flat slot pointers because they aren't strong enough and will bend under overloads.

Figure 6. Three basic pointers



High weight pointers pose additional problems. Higher

weight results in lessened torque to weight ratio, thus lowering performance for a given sensitivity. Increased inertia of the heavier pointer slows response time and lowers the damping factor. For precision work, a knife edge pointer is most satisfactory. When distant viewing is required, a spade or lance type is recommended.

Some nylon pointers are used today. Nylon offers high strength, flexibility and extreme resistance to breaking, but does present problems. The moment of inertia of nylon is greater than that of a tubular metal pointer. The absorption of moisture may increase its weight and shift the balance of the meters. Also, nylon has a tendency to pick up electrostatic charges, particularly at low humidities.

Customized For Your Needs

The ranges and styles listed in this catalog is only a guide for the specifying engineer. Simpson will supply any meter with custom scales, any practical range and painted trim front. In many instances we can offer special resistance, improved accuracy and tracking, knowledge and experience to solve your meter problems. Frequently, unusual requirements can be solved by one of our many existing successful applications. When considering an analog meter, the table below will help you in your selection by providing you with the most suitable analog meter for your application. If you need further assistance call Simpson Electric Company (708) 697-2260 or fax your meter specifications to Simpson (708) 697-2272.

Specifications	Unit to be measured
	Range
	Power Consumption (Sensitivity)
	Accuracy(at 77°F, Normal Mounting)
	Type of Movement
	Scale Law
Consult Catalogs	Style
	Size
	Pointer/Color
	Scale Design
	Terminals
	Panel Space
Environmental Factors	Ambient Temperature
	Magnetic Panels and Stray Fields
	Shock and Vibration
	Moisture and Dirt
	Mounting Position
	Tracking Accuracy
Performance Factors	Repeatability
	Symmetry
	Response Time
	Damping Factor
	Frequency Response
	Overload Protection
	Position Influence

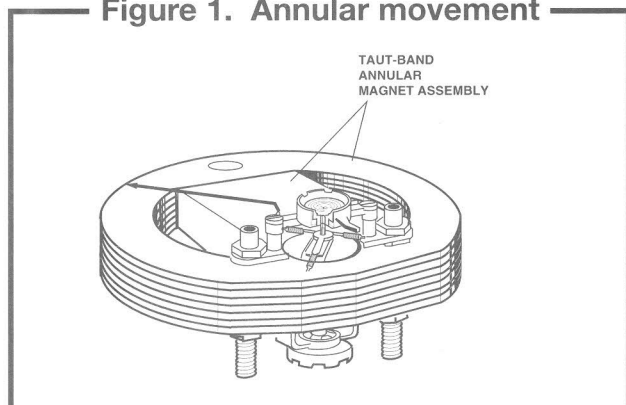


Featured on the following pages are some of the excellent meter movements designed and engineered by Simpson. The information in this section is intended to give you a basic understanding of the operating principles and some of the factors influencing the accuracy and the operations of the various movement types. If you need further assistance, send in your specifications and application and let Simpson's Engineering Department recommend the meter movement required.

Pivot and Jewel or Taut-Band

Simpson's annular meter movement design (Figure 1) has such excellent magnetic properties that it is very stable even under the most severe shock and vibration conditions. Simplification of assembly, self-shielding, reduction of weight, full bridge construction, improved linearity and good shock resistance ... are all available as product benefits at a price you can easily afford. Where pivot and jewel construction is used, greater shock resistance is obtained by the use of special spring cushioned jewels.

Figure 1. Annular movement



The efficiency of the annular magnet system has been made to meet a much higher than ordinary torque to weight ratio reducing friction and increasing ruggedness. The self-shielding movement permits use on magnetic or non-magnetic panels without special calibration. Stray magnetic fields that usually cause errors of up to 10% in ordinary meters produce less than 1/10% in this high quality annular meter movement design. In addition, the annular movement is an excellent general purpose movement. It is especially desirable when external magnets fields may be encountered or where severe vibration conditions cause calibration changes of conventional movements.

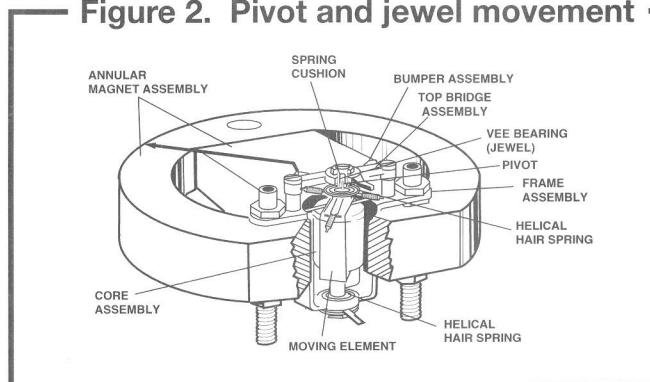
Annular, Pivot and Jewel

The moving coil in Pivot and Jewel movements is supported by two pointed shafts (pivots) in a pair of VEE bearings (jewels) (see cutaway illustration Figure 2). Restoring force on the system is provided by one or more helical hair springs. In D'Arsonval mechanisms, the hair springs also serve to carry the current to the moving coil.

Analog Panel Meters

Panel Meter Movements

Figure 2. Pivot and jewel movement



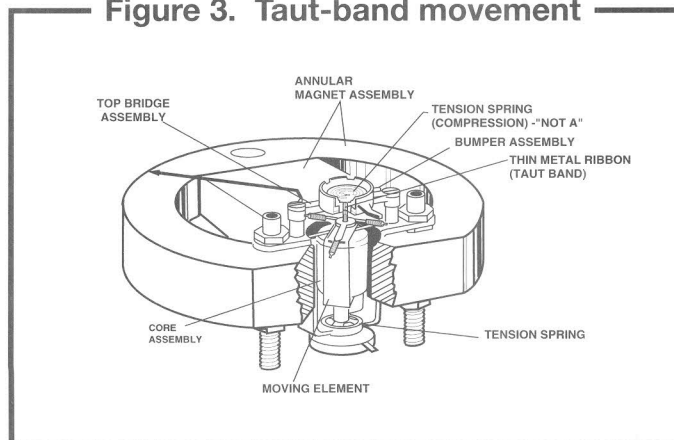
In Pivot and Jewel movements, rubbing friction between the jewel and the highly polished pivot results in a slight lag of the moving element behind the actual position in a "perfect" system. This is termed "friction." Lightly tapping a meter with a Pivot and Jewel movement "washes out" most friction error. Although high impact shock or vibration can damage the pivots or jewels resulting in increased friction, complete failure to operate is very unlikely because high torques are readily achieved for high speed applications.

Pivot and Jewel movements, generally low in cost, provide a maximum speed of response and continue to operate under vibration despite occurrence at many frequencies.

Annular, Taut-Band

In Taut-Band movements (Figure 3), the moving element is supported by two thin metal ribbons. These ribbons are kept under tension by special springs at each end of the assembly. In addition to supporting the moving element, the bands (ribbons) also provide the restoring force on the system and carry the current to the moving coil in the D'Arsonval mechanisms.

Figure 3. Taut-band movement





Analog Panel Meters

Panel Meter Movements

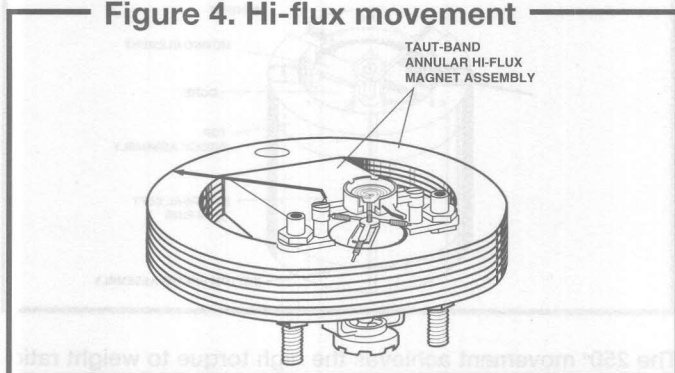
Since there is no physical contact between the moving parts, there obviously can be no friction. However, termination of the bands causes a lag which produces an effect similar to the "friction" in a Pivot and Jewel movement. In Taut-Band movements, this is called "hysteresis," but cannot be tapped out. The hysteresis remains essentially the same regardless of the torque and is easily noted through repeatability checks. This feature gives the movement its exceptionally high repeatability actions.

Taut-Band movements operate at extremely high repeatability without appreciable error even at very low power levels. They are ideal for extremely low power inputs (.005 milliwatts or less) and are not subject to "wear," even on continually changing deflections, over extremely low periods. Long life without change in performance regardless of changing input levels is a major advantage of these movements.

Annular, Hi-Flux

The Hi-Flux Annular Movement (Figure 4), incorporates a larger and more powerful magnet assembly which permits

Figure 4. Hi-flux movement



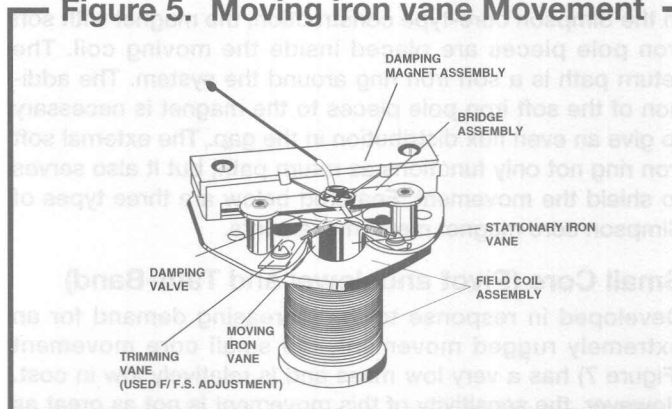
this movement to meet unusual and otherwise restrictive specifications. Extremely high sensitivities are possible wherein the instrument responds to minute amounts of current. Considerably lower resistance than normal can be supplied on microammeters. Special ballistic requirements can more easily be met.

Moving Iron Vane (Magnetic Damping)

The moving iron vane movement (Figure 5) is still the preferred means of measuring RMS values of AC voltage and current below 1000 CPS. The movement is a rugged repulsion attraction type employing a magnetic damping system. An almost uniformly divided scale provides excellent readability.

This movement has been especially developed for severe service conditions where shock and vibration would destroy or limit the life of some movements of this type.

Figure 5. Moving iron vane Movement



The moving element rides on specially hardened, polished steel pivots rotating in spring loaded jewels. Damping of the moving element is provided for by the Eddy currents induced in a specially formed aluminum vane as it moves through a high density magnetic field.

Dynamometer

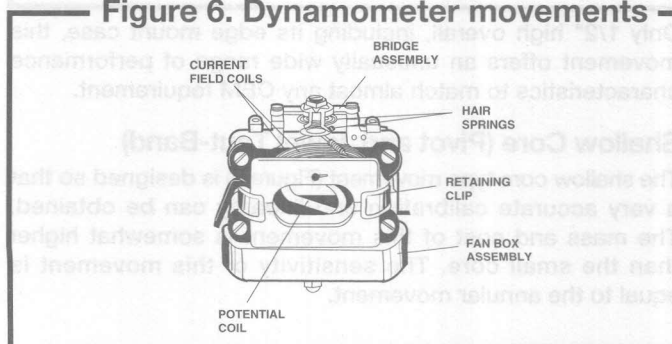
The Dynamometer type instrument (Figure 6), is the most practical means of determining true power in AC or DC circuits. This air damped movement utilizes the same high quality Pivots and Jewels as other fine Simpson Meters to support the moving element. The potential coil is wound on a split, oval shaped aluminum form. The unusual shape produces an essentially linear wattage scale and reduces the overall size of the movement. This permits Simpson to produce a 2-1/2" panel wattmeter ... still the only American manufacturer to produce a stock wattmeter in this small size. The self-contained wattmeters produced by Simpson share the desirable ability of other quality wattmeters accuracy on DC and a wide frequency range on the AC less than 2% change in indication from 25 through 400 Hz.

Core Magnet Movements

Core magnet movements were developed to fill needs. Basic characteristics include:

1. Self-shielding
2. Relatively low mass
3. Concentric construction

Figure 6. Dynamometer movements





Analog Panel Meters

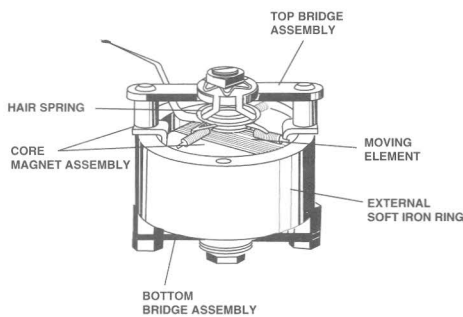
Panel Meter Movements

In the Simpson core-type construction, the magnet with soft iron pole pieces are placed inside the moving coil. The return path is a soft iron ring around the system. The addition of the soft iron pole pieces to the magnet is necessary to give an even flux distribution in the gap. The external soft iron ring not only functions as return path, but it also serves to shield the movement. Featured below are three types of Simpson core magnet meter movements.

Small Core (Pivot and Jewel and Taut-Band)

Developed in response to the increasing demand for an extremely rugged movement, the small core movement (Figure 7) has a very low mass and is relatively low in cost. However, the sensitivity of this movement is not as great as the large core types.

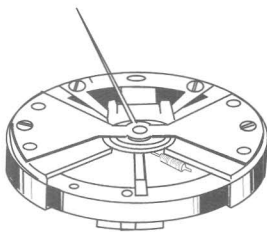
Figure 7. Small core movement



Thin Core (Pivot and Jewel)

Consistent with increasing call-outs for high density packaging, Simpson designed a high efficiency Thin Core movement (Figure 8).

Figure 8. Thin core movements

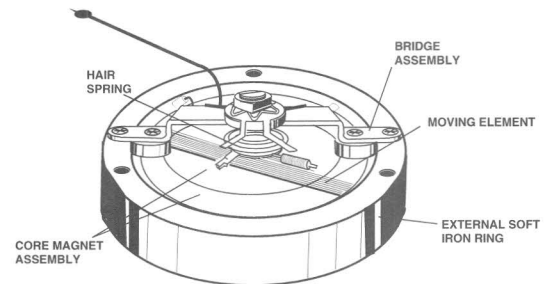


Only 1/2" high overall, including its edge mount case, this movement offers an unusually wide range of performance characteristics to match almost any OEM requirement.

Shallow Core (Pivot and Jewel Taut-Band)

The shallow core type movement (Figure 9) is designed so that a very accurate calibration and linearity can be obtained. The mass and cost of this movement is somewhat higher than the small core. The sensitivity of this movement is equal to the annular movement.

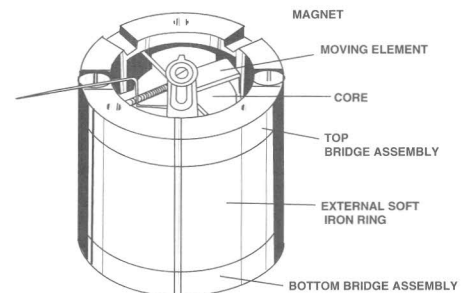
Figure 9. Shallow core movement



250 Degree Movement

The Simpson 250° movement (Figure 10), is designed to provide reliable accurate readings for applications that require long scale length of 250° of rotation as compared to the standard 90° or 100° annular type movement.

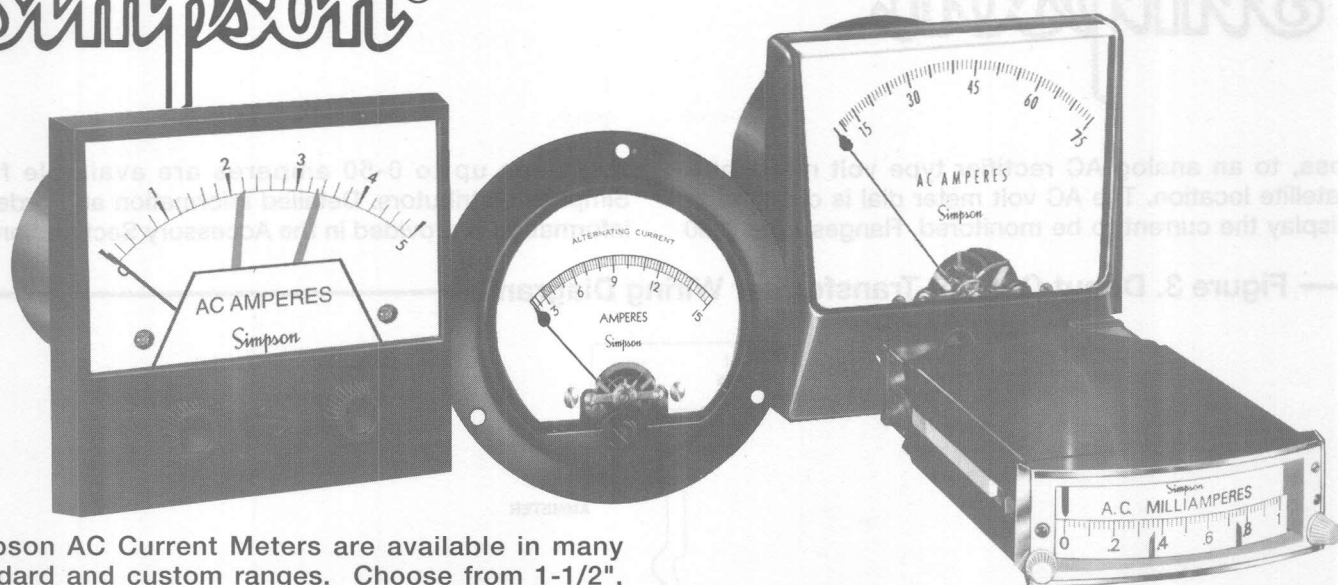
Figure 10. 250 Degree movement



The 250° movement achieves the high torque to weight ratio through the proper selection of magnetic materials, the development of a superior magnetic circuit and the selection of the correct air gap size. The highly precise balance of these factors is made possible by the vast storehouse of knowledge gathered over the years by Simpson's Engineering Department. The result is a movement that has exceptional ballistic characteristics, linearity and extremely long term accuracy. The unit can be supplied as a movement only to fit into your special case, or as the basic operating movement in a 3-1/2" round or square or 4-1/2" round panel meter. The 250° design is presently in the Pivot and Jewel construction. Spring loaded jewels support the moving system and through the proper selection of pivot radius versus jewel radius, as well as control of material, withstands extreme environmental shock and vibration. The moving system does not require a solid shaft and is designed to minimize overall weight. The pointer counterbalances the weight of the coil assembly and hence the longer the pointer the less weight required.

Simpson®

AC Current Meters



Simpson AC Current Meters are available in many standard and custom ranges. Choose from 1-1/2", 2-1/2", 3-1/2", 4-1/2" and 4x6" sizes. Case styles include Round and Rectangular, Wide-Vue, Rugged Seal, 250° Long Scale, Designer, Century, Edgewise, and Tru-Vue. Movements are Iron-Vane and Rectifier types. Rectifier type movements are generally selected when high sensitivity and relatively wide frequency response are required. Such meters are not suitable for measurements of non-sinusoidal waveforms. Moving iron-vane instruments are used for non-sinusoidal wave forms, and where economy is essential. Their frequency response is flat only from 25 to 125 cps and sensitivity is limited.

While the Simpson Family of AC current meters all measure alternating current, they are not exactly alike and differ in their applications. The Wide-Vue features modern styling with a durable, open-faced plastic cover for wide-angle readability and protection of the meter face. Round and Rectangular, Designer and Century series offer easy reading, attractive design and choice of case styles. The 250° Long Scale meter is designed for applications that require high accuracy readings. 250° panel meters provide more than double the scale length of the standard models. Tru-Vue models feature a modern, clear acrylic front and clean, open scale to update your panel design. And finally, where every square inch counts or weight is a consideration, the 3-1/2" Edgewise meter fills these requirements.

Simpson offers several types of current transformers enabling you to monitor amperage readings at a remote site 50 feet away and at a local site when current levels exceed 50 amperes.

Generally, 2-1/2" AC current meters are self-contained through 50 amperes and 3-1/2" and 4-1/2" through 75 amperes. Higher range AC current meters are 5 ampere meters and require external donut (toroid) current transformers.

The donut transformer used with switchboard and

panel current meters enables an AC current meter to monitor a high amperage measurement by reducing the current to the AC current meter to 5 amperes. In addition, the donut transformer simultaneously isolates the AC current meter from the line.

Donut transformers are specified by current ratio such as 100:5, where the number 100 is the rated input current to the transformer and the second number 5 is the amperes output of the transformer to the AC current meter. Donut transformers offered by Simpson range from 50:5 all the way up to 1000:5. Other ratings are available on special order. For more detailed information refer to the Accessories Section of this Engineering Application Guide.

Figure 1. Donut Current Transformer

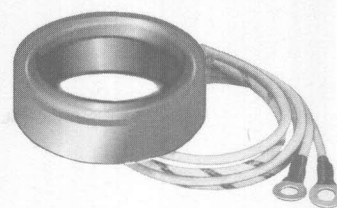
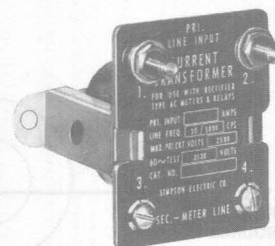


Figure 2. 186 Current Transformer



The Model 186 Current Transformer is used for long distance remote current monitoring. A current signal ranging from 50 milliamps to 50 amps is converted into a 0-10 volt AC signal by the transformer and can be easily transmitted 50 feet away, with negligible line



AC Current Meters

loss, to an analog AC rectifier type volt meter at a satellite location. The AC volt meter dial is changed to display the current to be monitored. Ranges from 0-50

milliamps up to 0-50 amperes are available from Simpson distributors. Detailed information and ordering information is provided in the Accessory Section herein.

Figure 3. Donut Current Transformer Wiring Diagram

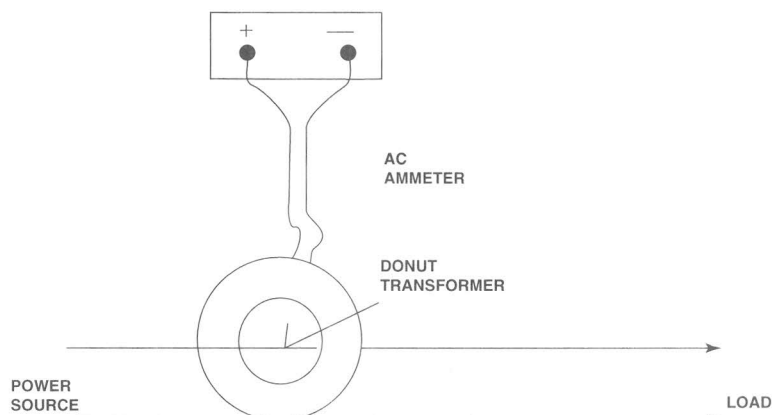
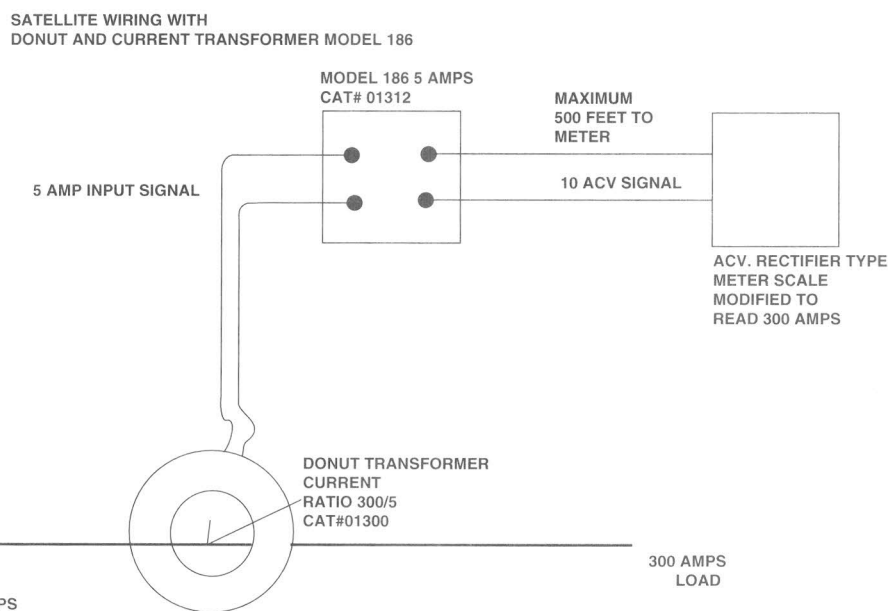
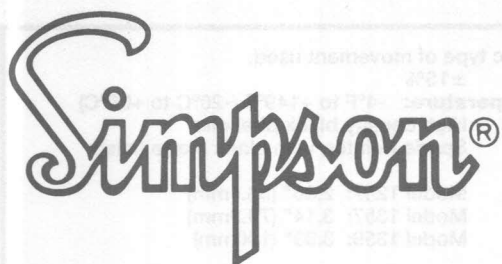


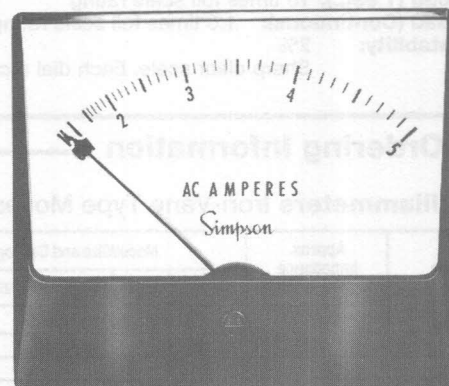
Figure 4. Satellite Meter Wiring Diagram





AC Current Meters

Wide-Vue Style



- Wide Angle Visibility
- UL Recognized
- Phenolic Cases with Clear Acrylic Windows
- Distinctive Case Styles
- Three Popular Sizes: 2-1/2", 3-1/2", and 4-1/2"
- Optional Bezel and Illumination Kits

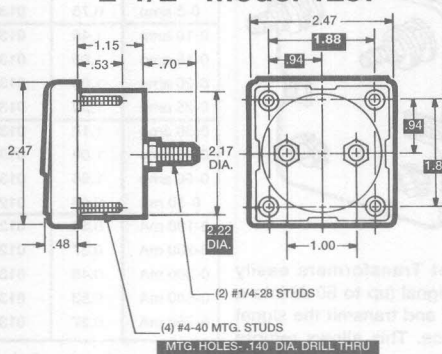
Molded in a black phenolic case, this distinctive style meter with clear acrylic window provides wide angle visibility and can either be surface mounted or bezel mounted (semi-flush mount) with one of Simpson's Wide-Vue bezel kits. Available in three standard sizes of 2-1/2", 3-1/2", and 4-1/2", the Wide-Vue is ideal for reliable measurement of AC current ranges between 1 and 300 amps or 10 and 500 milliamps. In addition, Simpson offers dual range units in 3-1/2 and 4-1/2 inch sizes that measure both 0-150 volts and 0-5 amps on one dial. AC meters measuring current inputs between 5 and 50 amps can be ordered as self-contained units

Model Number	Size	Meter Movement
1257	2-1/2"	Iron-Vane
1357	3-1/2"	Iron-Vane
1359	4-1/2"	Iron-Vane

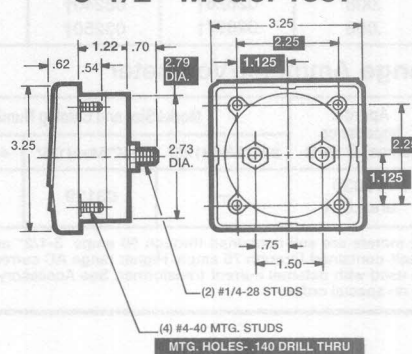
or as 5 amp panel meters to be used with an optional external transformer. Current inputs above 75 amps must be used with an external transformer. All units are guaranteed to $\pm 2\%$ full scale accuracy and meet American National Standards Institute specification ANSI C39.1.

Dimensions and Compatibility

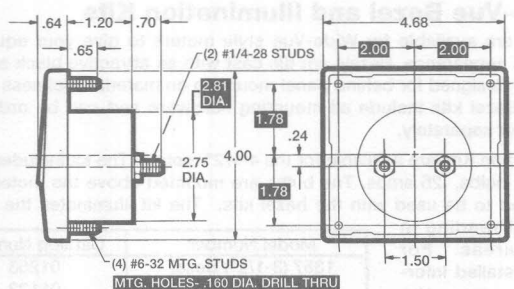
2-1/2"-Model 1257



3-1/2"-Model 1357



4-1/2"-Model 1359



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton			
Celebrity	223	225	227
Challenge	362	363	364
Clearvu	233	235	237
Hoyt 3100	3125	3135	3145
Modutec			
S Series	2S-	3S-	4S-
PB Series	2PB*	3PB*	4PB
Triplett G Series	220-G	320-G	420-G
Weston 2000 Series	2021	2031	2041
Yokogawa			
Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1
Horizon	251-210	251-310	251-410

*Modutec uses a three-stud mount.

Specifications

Accuracy:	±2% F.S.
Movement:	Iron-Vane, magnetically damped
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to

	track the specific type of movement used.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 1257: 2.30" (58.4mm) Model 1357: 3.14" (79.9mm) Model 1359: 3.93" (100mm)
Net Weight:	Model 1257: 4 oz. (0.11kg) Model 1357: 8 oz. (0.14kg)

Ordering Information

AC Milliammeters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 1257	3-1/2" Model 1357	4-1/2" Model 1359
0-10	1,650	06294	06625	06665
0-50	80	06295	06630	06670
0-100	17.2	06296	06640	06680
0-250	3.15	06297	06650	06690
0-500	0.9	06300	06660	06699

AC Current Meters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 1257	3-1/2" Model 1357	4-1/2" Model 1359
0-1	.213	02560	03130	03260
0-1.5	.105	02570	03140	03270
0-2	.065	< >	03150	03280
0-3	.028	02575	03160	03290
0-5	.008	02580	03170	03300
0-10	.004	02590	03180	03310
0-15	.0025	02599	03190	03320
0-25	.002	02609	03200	03330
0-30	.0015	02615	03205	03335
0-50	.001	02619	03210	03340
0-75	.0002	< >	03215	03345
0-100	.008	02622†	03220†	03350†
0-150	.008	02624†	03230†	03360†
0-200	.008	02626†	03240†	03370†
0-300	.008	02627†	03250†	03380†

AC Dual Range Ammeter/Voltmeter

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 1257	3-1/2" Model 1357	4-1/2" Model 1359
0-150V and 0-5A	15030 and .021	—	03129	03259

† 2-1/2" AC current meters are self-contained through 50 amps. 3-1/2" and 4-1/2" AC current meters are self-contained through 75 amps. Higher range AC current meters are 5 amp meters to be used with external current transformer. See Accessory Panel to the right. < > Available on special order.

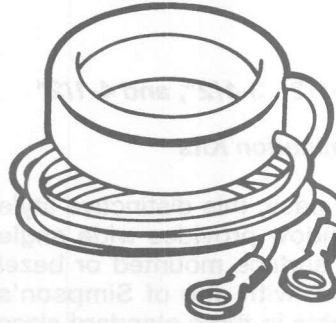
Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	39-40
DC Current	C	71-72
DC Voltage	C	99-100
Decibels	C	129-130
RF Current	C	159-160
VU	C	169-170
Watts	C	180-181
DC Galvanometers	C	71-72

Accessories

Donut Transformer

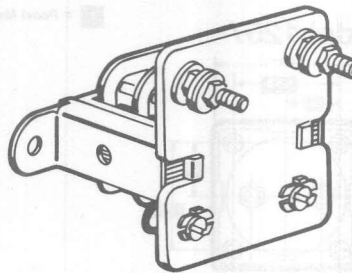


A Donut Current Transformer enables Current Meters to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer



Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.

Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

Wide-Vue Bezel and Illumination Kits

Bezels are available for Wide-Vue style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered with meters or separately.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas. For more Detailed Information see the accessory section.

Model Number	Catalog Number
1357 (3-1/2") Bezel	01253
1359 (4-1/2") Bezel	01123
1359 Illumination Kit	01165

Specifications

Accuracy:	±2% F.S. (at 25° C 60 Hz sine wave)
Movement:	Iron-Vane, magnetically damped
Suspension:	Pivot and Jewel
Tracking:	±3%
Repeatability:	2%
Shielding:	Calibration is unaffected by stray magnetic field or panel mounting.
Response Time:	1.5 seconds maximum above 10 mA.
Overload (1 sec.)	10 times full scale rating.
Overload (Continuous):	1.5 times full scale rating

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Resistance:	± 15%
Case:	Clear plastic
Pointer:	Knife edge, black matte finish
Scale Length:	Model 953: 2.94" (74.68mm) Model 954: 3.53" (89.66mm)
Net Weight:	Model 953: 6 oz. (.17 kg) Model 954: 8 oz. (.23 kg)

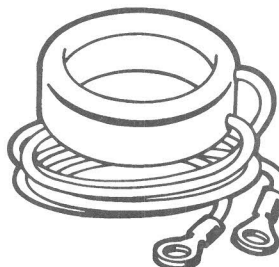
Ordering Information

SIZE	FUNCTION	RANGE	≈ ohms
3			
4			
3-1/2"			
4-1/2"			
AC Milliamps (Iron-Vane Movement)	AMA	010	0-10 ACmA 1650
	AMA	050	0-50 ACmA 80
	AMA	100	0-100 ACmA 17.2
	AMA	150	0-150 ACmA 7.16
	AMA	250	0-250 ACmA 3.15
	AMA	500	0-500 ACmA 0.9
AC Amps (Iron-Vane Movement)	AAA	001	0-1 ACA 0.213
	AAA	1R5	0-1.5 ACA 0.105
	AAA	002	0-2 ACA 0.065
	AAA	003	0-3 ACA 0.028
	AAA	005	0-5 ACA 0.008
	AAA	010	0-10 ACA 0.004
	AAA	015	0-15 ACA 0.0025
	AAA	025	0-25 ACA 0.002
	AAA	030	0-30 ACA 0.0015
	AAA	050	0-50 ACA 0.001
	AAA	075	0-75 ACA 0.008
	AAA	100	0-100 ACA 0.008
	AAA	150	0-150 ACA 0.008
	AAA	200	0-200 ACA 0.008
	AAA	300	0-300 ACA 0.008

NOTE: AC current meters above 50 amps are 5 amp meters to be used with external current transformers. AC current meters between 5 and 50 amps can be supplied as self contained units (standard) or as 5 amp meters to be used with external current transformers (optional) from factory. See Accessory panel to the right.

Accessories

Donut Transformer

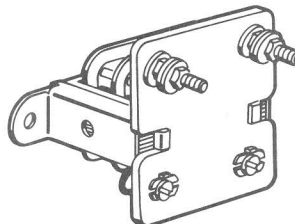


A Donut Current Transformer enables these Current Meters to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer



Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.

Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

Function Reference Table

For your convenience, the table below lists Tru-View models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	41-42
DC Current	C	73-74
DC Voltage	C	103-104

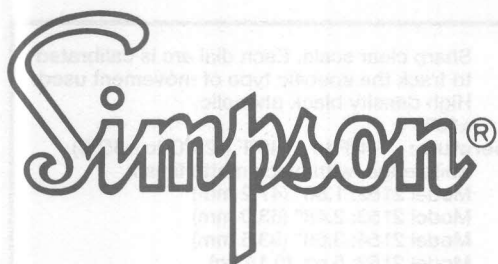
Tru-View Bezel and Illumination Kits

Behind panel bezels are available for Tru-View style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered with meters or separately. Refer to Accessory Section for detailed information.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas. Refer to Accessory Section for detail information.

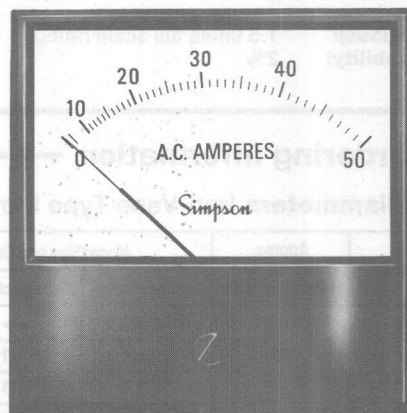
Ordering Information

Model Number	Catalog Number
953 (3-1/2")	TV3BK
954 (4-1/2")	TV4BK
Illumination Kits	01165



AC Current Meters

Century Style



Model Number	Size	Meter Movement
2152	2-1/2"	Iron-Vane
2153	3-1/2"	Iron-Vane
2154	4-1/2"	Iron-Vane

C
1
7

■ **UL Recognized**

■ **± 2 % of Full Scale Accuracy**

■ **Phenolic Cases and Glass Windows**

■ **Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"**

An attractive design for industrial or commercial applications, the Century offers maximum reliability and is accurate to ±2 percent of full scale on all readings. Whether specified for an original design or as a replacement, the Century offers an Iron-Vane movement that allows the instrument to be mounted on steel panels. Models are available to measure various current ranges up to 300 amps and are calibrated for a frequency range of 25 through 800 Hz.

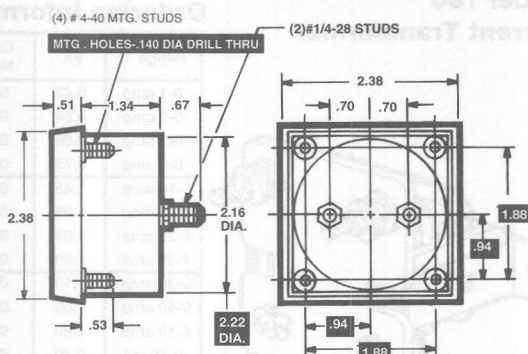
These easy-to-read meters, molded in a black phenolic housing with a large glass viewing window, come in three different sizes of 2-1/2", 3-1/2" and 4-1/2". The 2-1/2" meters are self-contained through 50 amps whereas the 3-1/2" and 4-1/2" meters are self-contained through 75 amps. Higher range readings require an external transformer mentioned herein. Dual range

scales can be ordered for the 4-1/2" meter as well as custom dials to fit your specific application. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

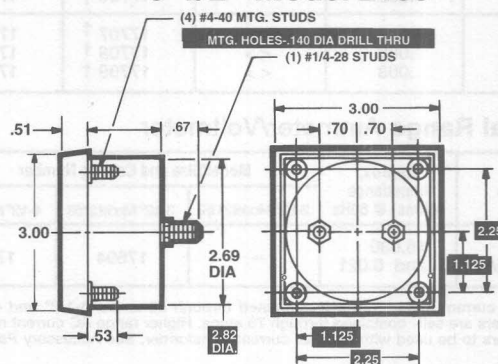
Dimensions and Compatibility

2-1/2"-Model 2152

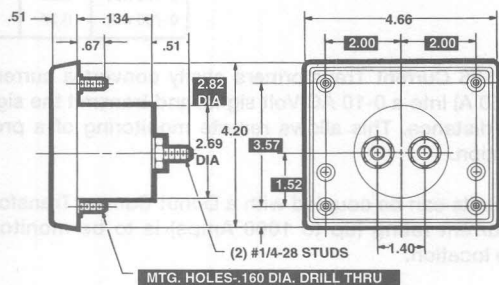
1 = Panel Meter Cut-out Dimensions



3-1/2"-Model 2153



4-1/2"-Model 2154



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton Amerint	233	235	237
Hoyt	4026	4036	4046
Modutec S Series	2S-	3S-	4S-
Triplett G Series	230-GL	330-GL	430-GL
Weston 2000 Series	2024	2034	2044
Yokogawa Horizen	251-210	251-310	251-410

Specifications

Accuracy:	±2% F.S.
Movement:	Iron-Vane, magnetically damped
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Knife edge, with black matte finish.
Scale Length:	Model 2152: 1.86" (47.2 mm) Model 2153: 2.48" (63.0 mm) Model 2154: 3.68" (93.5 mm)
Net Weight:	Model 2152: 5 oz. (0.14 kg) Model 2153: 6 oz. (0.17 kg) Model 2154: 9 oz. (0.26 kg)

Ordering Information

AC Milliammeters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 2152	3-1/2" Model 2153	4-1/2" Model 2154
0-10	1,650	17680	< >	17760
0-50	80	17681	17716	17761
0-100	17.2	17682	17717	17762
0-250	3.15	17683	17718	17763
0-500	0.9	17684	17719	17764

AC Current Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 2152	3-1/2" Model 2153	4-1/2" Model 2154
0-1	.213	17665	17695	17740
0-1.5	.105	17666	< >	< >
0-2	.065	< >	17697	17742
0-3	.028	17667	17698	17743
0-5	.008	17668	17699	17744
0-10	.004	17669	17700	17745
0-15	.0025	17670	17701	17746
0-25	.002	17671	17702	17747
0-30	.0015	17672	17703	17748
0-50	.001	17673	17704	17749
0-75	.0002	< >	17710	17755
0-100	.008	17674†	17706 †	17751 †
0-150	.008	< >	17707 †	17752 †
0-200	.008	< >	17708 †	17753 †
0-300	.008	< >	17709 †	17754 †

AC Dual Range Ammeter/Voltmeter

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 2152	3-1/2" Model 2153	4-1/2" Model 2154
0-150V and 0-5A	15,030 and 0.021	—	17694	17739

†2-1/2" AC current meters are self-contained through 50 amps, 3-1/2" and 4-1/2" AC current meters are self-contained through 75 amps. Higher range AC current meters are 5 amp meters to be used with external current transformer. See Accessory Panel to the right.

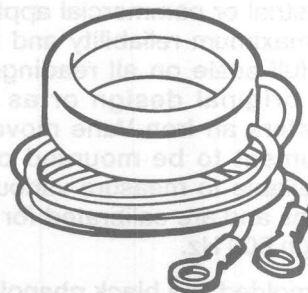
Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
DC Voltage	C	105-106
AC Voltage	C	43-46
DC Current	C	75-76
RF Current	C	161-162
Decibels	C	131-132
Watts	C	182-183
DC Galvanometers	C	75-76

Accessories

Donut Transformer

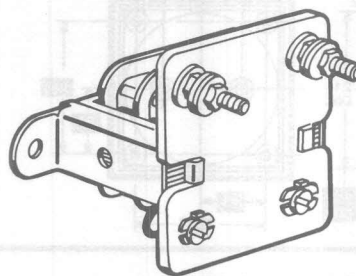


A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer

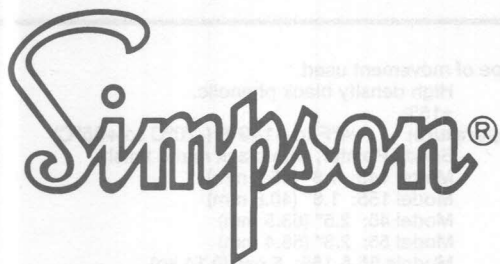


Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

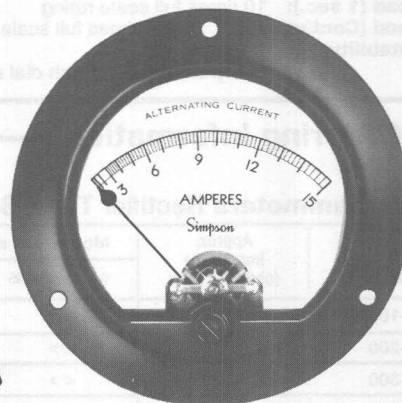
Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.



AC Current Meters

Round Style



- **UL Recognized**
- **Distinctive Case Style**
- **Phenolic Cases and Glass Windows**
- **Two Popular Sizes: 2-1/2", 3-1/2"**

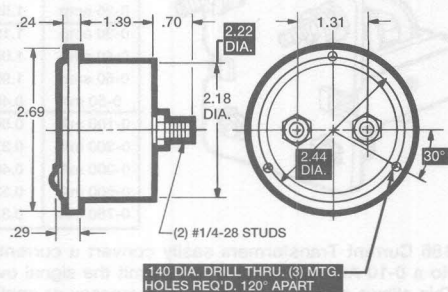
For industrial or commercial applications, the Round style panel meter offers maximum reliability and $\pm 2\%$ F.S. accuracy for all ranges. With a black phenolic case and glass window for optimum viewing, the Round style meter is a popular selection for industrial applications because the cover extends to the back of the case. AC units have either iron-vane type or rectifier type movements and are calibrated at 60 Hz. Iron-vane type current meters have a frequency range of 25 to 800 Hz (for $\pm 1\%$ deviation from value at 60 Hz). All rectifier types have a 25 Hz to 10 KHz range. Two different standard sizes of 2-1/2" and 3-1/2" are available to measure various current ranges. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
155	2-1/2"	Iron-Vane
145*	2-1/2"	Annular-Rectifier
45	3-1/2"	Annular-Rectifier
55	3-1/2"	Iron-Vane

* = Special Order

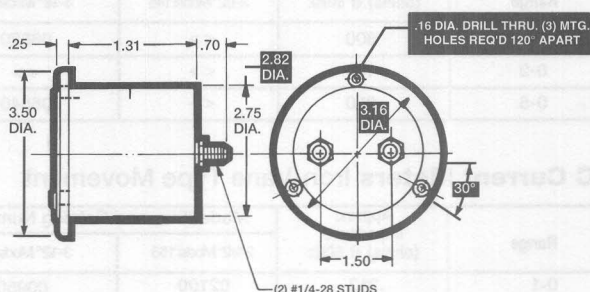
Dimensions and Compatibility

2-1/2"-Model 155

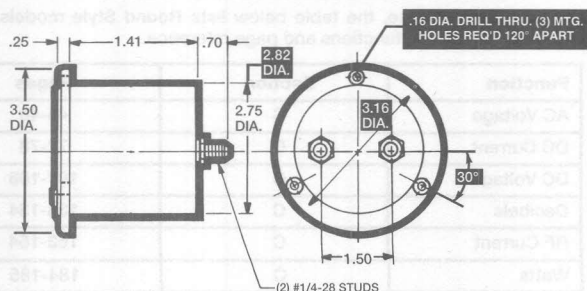


Note: Dimensions Are Also Used For Model 145

3-1/2"-Model 45



3-1/2"-Model 55



Compatibility Reference Table

Manufacturer	Size/Model	
	2-1/2"	3-1/2"
Beede	501	310
Hoyte	552	584
Triplett S Series	231-S	331-S
Weston 200 and 300	204	304

Specifications

Accuracy:	±2% F.S. (Iron-Vane), ±3% F.S. (Rectifier)
Movement:	Models 55, 155: Iron-Vane, magnetically damped Models 45, 145: Annular Rectifier type.
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track

	the specific type of movement used.
Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 145: 1.8" (45.7 mm) Model 155: 1.6" (40.6 mm) Model 45: 2.5" (63.5 mm) Model 55: 2.3" (58.4 mm)
Net Weight:	Models 55 & 155: 5 ozs (0.14 kg) Models 145 & 45: 7 ozs (0.20 kg)

Ordering Information

AC Microammeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 145	3-1/2" Model 45
0-100	3400	< >	04080
0-200	2400	< >	< >
0-300	1800	< >	< >
0-500	1200	< >	< >

AC Millimeters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 155	3-1/2" Model 55
0-10	1650.0	< >	< >
0-15	887.0	< >	05380
0-25	270.0	< >	< >
0-50	80.0	< >	05400
0-100	17.2	< >	05410
0-250	3.1	06080	05420
0-500	.9	< >	05430

AC Millimeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 145	3-1/2" Model 45
0-1	600	< >	06820
0-2	400	< >	< >
0-5	200	< >	06840

AC Current Meters Iron-Vane Type Movement

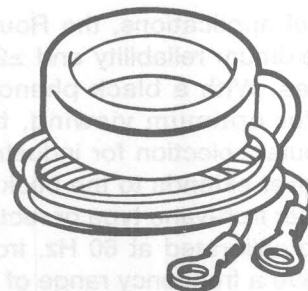
Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 155	3-1/2" Model 55
0-1	.213	02100	00950
0-1.5	.105	< >	00960
0-2	.065	02120	00970
0-3	.028	02130	00980
0-5	.008	02140	00990
0-10	.004	02150	01001
0-15	.0025	02160	01010
0-25	.002	02170	01020
0-30	.0015	02180	01030
0-50	.001	02190	01040
0-75	.0002	< >	03432
0-75	.008	02200†	< >
0-100	.008	02210†	01060†
0-150	.008	02220†	01070†
0-200	.008	< >	01080†
0-250	.008	02240†	01090†
0-300	.008	< >	01100†
0-500	.008	02260†	01110†

< > Available on special order.

† These meters are 5 amp meters with scales as indicated and require external donut transformers. Refer to Accessory section or chart to the right for detailed information.

Accessories

Donut Transformer

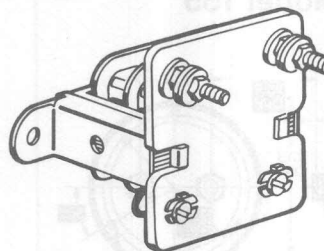


A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer



Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.

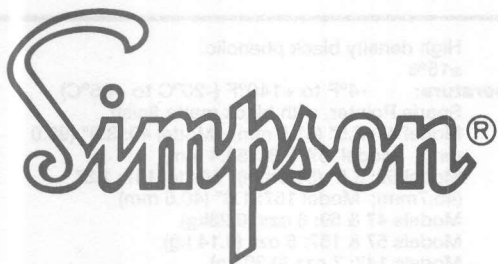
Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

Function Reference Table

For your convenience, the table below lists Round Style models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	45-46
DC Current	C	77-78
DC Voltage	C	107-108
Decibels	C	133-134
RF Current	C	163-164
Watts	C	184-185
DC Galvanometers	C	77-78

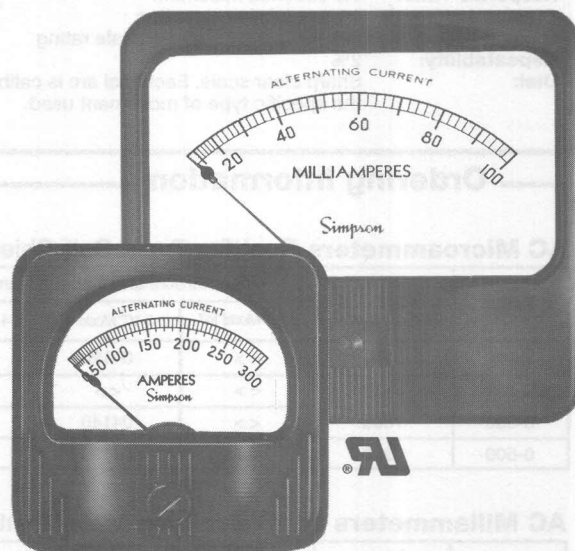


AC Current Meters

Rectangular Style

- **UL Recognized**
- **Phenolic Case**
- **Glass Window**
- **Distinctive Case Style**
- **Six Different Models**
- **Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"**

For unsurpassed stability and quality performance look to Simpson's rectangular style meters. The rectangular style offers a popular look with sharp, beveled edges and glass windows for easy viewing. AC units have either iron-vane or rectifier type movements. All ranges are calibrated to 60 Hz. Iron-vane type current meters have frequency ranges of 25-800 Hz (for $\pm 1\%$ deviation from value at 60 Hz). All rectifier types have 25 Hz to 10 KHz range. Three different standard sizes of 2-1/2", 3-1/2", and 4-1/2" are available to measure various AC current ranges including amps, milliamps, and microamps. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

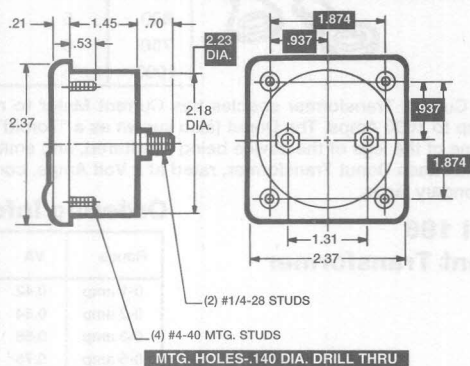


Model Number	Size	Meter Movement
157	2-1/2"	Iron-Vane
147	2-1/2"	Annular-Rectifier
57	3-1/2"	Iron-Vane
47	3-1/2"	Annular-Rectifier
59	4-1/2"	Iron-Vane
49	4-1/2"	Annular-Rectifier

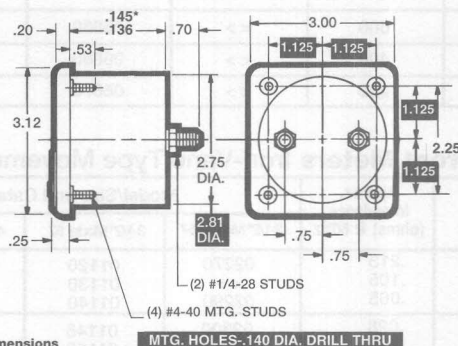
Dimensions and Compatibility

2-1/2"-Model 147 & 157

1 = Panel Meter Cut-out Dimensions

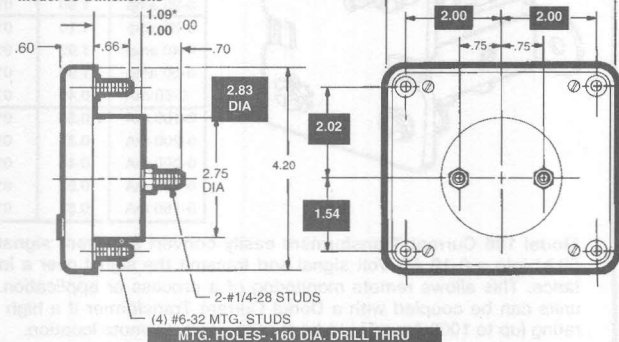


3-1/2"-Model 47 & 57



4-1/2"-Model 49 & 59

* Model 59 Dimensions



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Beede		15	16/458
Hoyt		598	648/684
Modutec PB Series	2PB*	3PB*	4PB
Triplett S Series	227-T	327-*T	420
Yokogawa Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1

*Modutec Meters use a three-stud mount.

Specifications

Accuracy:	±2% F.S. (Iron-Vane), ±3% (Rectifier)
Movement:	Models 57, 59, 157: Iron-Vane, magnetically damped Models 47, 49, 147: Annular Rectifier type, self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 47: 2.5" (63.5 mm); Model 49: 3.9" (99.0 mm); Model 57: 2.3" (58.4 mm); Model 59: 3.5" (89.0 mm); Model 147: 1.8" (45.7 mm); Model 157: 1.6" (40.6 mm)
Net Weight:	Models 47 & 59: 8 ozs (0.23 kg) Models 57 & 157: 5 ozs (0.14 kg) Models 147: 7 ozs (0.20 kg) Model 49: 11 ozs (0.31 kg)

Ordering Information

AC Microammeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 147	3-1/2" Model 47	4-1/2" Model 49
0-100	3400	< >	04120	04160
0-200	2400	< >	< >	04170
0-300	1800	< >	04140	04180
0-500	1200	< >	04150	04190

AC Millimeters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 157	3-1/2" Model 57	4-1/2" Model 59
0-10	1650.0	< >	05440	05510
0-15	887.0	< >	05499	< >
0-25	270.0	< >	05460	05530
0-50	80.0	06130	05470	05540
0-100	17.2	06140	05480	05550
0-250	3.1	06150	05490	05560
0-500	.9	< >	05500	05570

AC Millimeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 147	3-1/2" Model 47	4-1/2" Model 49
0-1	600	< >	06850	06880
0-2	400	< >	06860	< >
0-5	200	< >	06870	06900

AC Current Meters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 157	3-1/2" Model 57	4-1/2" Model 59
0-1	.213	02270	01120	01290
0-1.5	.105	< >	01130	01302
0-2	.065	02290	01140	01310
0-3	.028	02300	01145	01320
0-5	.008	02310	01160	01330
0-10	.004	02320	01170	01340
0-15	.0025	02330	01180	01350
0-25	.002	02340	01190	01360
0-30	.0015	02350	01200	01370
0-50	.001	02360	01210	01380
0-75	.0002	< >	03434	03436
0-75	.008	02370†	< >	< >
0-100	.008	02380†	01230†	01400†
0-150	.008	02390†	01240†	01410†
0-200	.008	< >	01250†	01420†
0-250	.008	02410†	01260†	01430†
0-300	.008	02420†	01270†	01440†
0-500	.008	02422†	01280†	01450†

< > Available on special order.

† These meters are 5 amp meters with scales as indicated and require external donut transformers. Refer to Accessory section or table at the right for detail information.

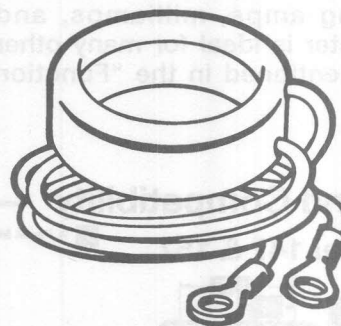
Function Reference Table

For your convenience, the table below lists Rectangular style models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	47-48
DC Current	C	79-80
DC Voltage	C	109-110
Decibels	C	135-136
RF Current	C	165-166
VU	C	173-174
Watts	C	185-186
DC Galvanometers	C	79-80

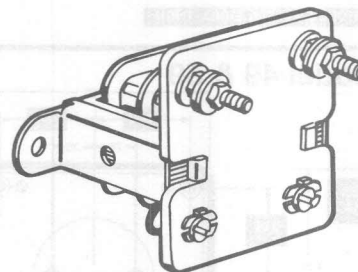
Accessories

Donut Transformer



A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Model 186 Current Transformer



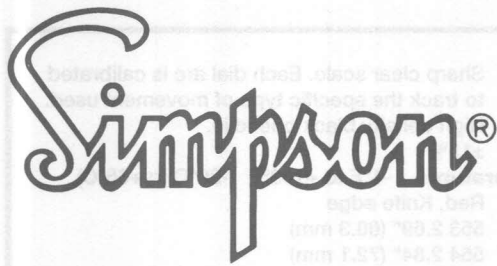
Model 186 Current Transformers easily convert a current signal (up to 50A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.

Ordering Information

Range/Amps	Catalog Number	
	Primary	Secondary
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

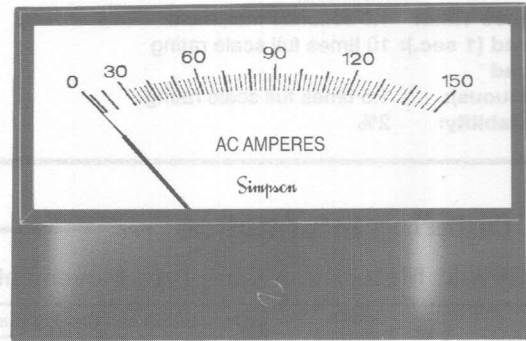
Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



AC Current Meters

Designer Style



Model Number	Size	Meter Movement
553	3-1/2"	Iron-Vane
554	4-1/2"	Iron-Vane

C
2
3

- **Clean, Uncluttered Look**
- **Phenolic Cases with Glass Windows**
- **Maximum Readability in Minimum Required Height**
- **Two Popular Sizes: 3-1/2", 4-1/2"**

Look to the Designer Series to be used in today's compact equipment designs — without sacrificing readability. The professional styling Designer meters offered by Simpson take up less than 3 inches of panel height, yet the scale is over 3-1/2 inches long.

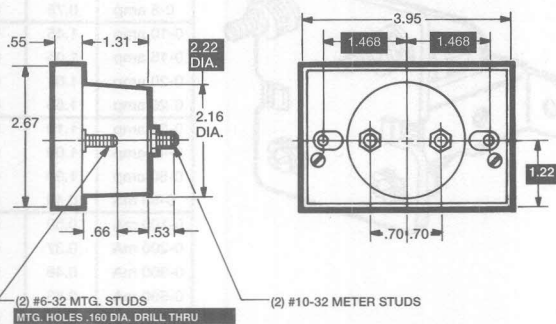
With a black phenolic case and glass window for optimum viewing, the Designer has a red knife-edge pointer, providing excellent readability and ± 2 percent of full scale accuracy. The 3-1/2 inch and 4-1/2 inch sizes feature an iron-vane magnetically damped meter movement allows the meter to be mounted in steel

panels with no affect to its calibration. All meters are calibrated at 60 Hz and have a frequency range of 25 through 800 Hz. This style can also be chosen for other electrical monitoring functions to fit your specific application. Refer to the "Function Reference Table" herein for the page number to obtain more detailed information for a specific function.

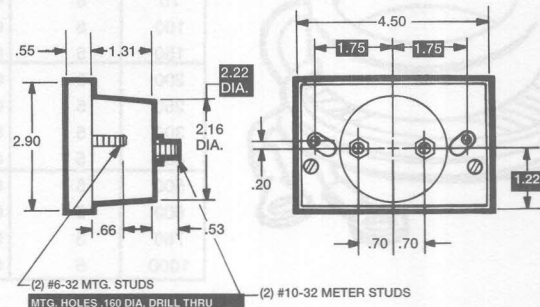
Dimensions and Compatibility

3 1/2"-Model 553

1 = Panel Meter Cut-out Dimensions



4 1/2"-Model 554



Compatibility Reference Table

Manufacturer	Size/Model	
	3 1/2"	4-1/2"
Hoyt	2136	2146
Triplett R Series	330-R	430-R

Specifications

Accuracy:	±2% F.S.
Movement:	Iron-Vane, magnetically damped
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload	
(Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Red, Knife edge
Scale Length:	553 2.69" (68.3 mm) 554 2.84" (72.1 mm)
Net Weight:	Model 553 5 oz. (0.14 kg) Model 554 6 oz. (0.17 kg)

Ordering Information

AC Current Meters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		3-1/2" Model 553	4-1/2" Model 554
0-1	.213	15049	15121
0-5	.008	15050	15120
0-10	.004	15052	15122
0-15	.0025	15051	15123
0-25	.002	15053	15125
0-50	.001	15054	15124
0-100	.008	15056††	15127††
0-150	.008	15057††	15128††

†† = Requires External Current Transformer

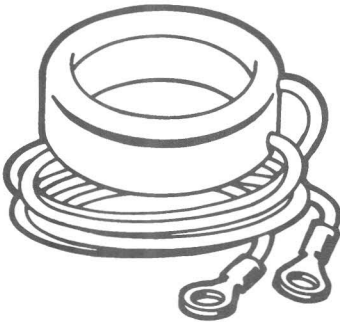
Function Reference Table

For your convenience, the table below lists Designer models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	49-50
DC Current	C	81-82
DC Voltage	C	111-112
VU	C	175-176

Accessories

Donut Transformer

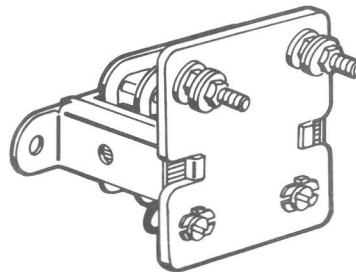


A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer

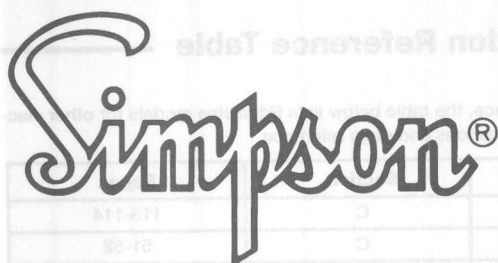


Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application.

These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location



AC Current Meters

Edgewise Style—3-1/2"



- **Compact and Lightweight**
- **Horizontal Mounting, Vertical on Special Order**
- **Quick, Front Panel Mounting**
- **Zero Adjust From Front Panel**
- **Accuracy at $\pm 3\%$ of Full Scale**
- **Self-Shielding Core Magnet Movement**

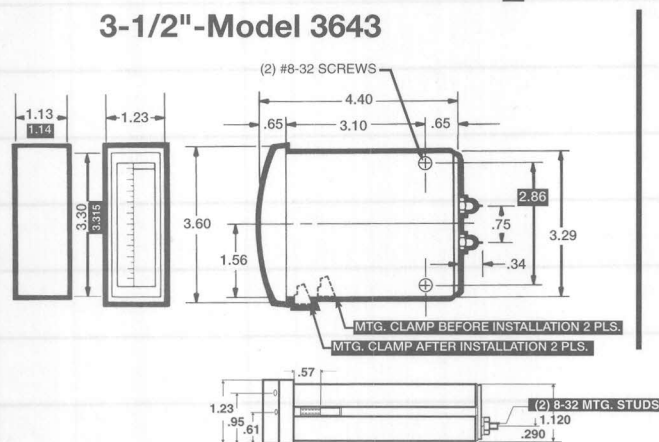
Model Number	Size	Meter Movement
3643	3-1/2"	Shallow Core Magnet-Rectifier

Simpson's Model 3643 Edgewise panel meter has been designed to satisfy the increasing demand for an attractive and accurate analog display in a minimum of panel space. The pivot and jewel suspension Edgewise meter provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility, unsurpassed stability and optimum performance.

A unique Simpson self-shielding 1-15/16" shallow core magnet rectifier movement provides $\pm 3\%$ of full scale standard accuracy for either horizontal or vertical (special order) scale orientations.

With the 3-1/2" Edgewise meter, panel mounting is simple and quick. A front bezel Allen screw operates a lock, which slides across a wedge-shaped cam surface, locking the instrument in place. When removing, the lock recesses into a slot on the side of the instrument. No additional mounting hardware is required. This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility



Compatibility Reference Table

Manufacturer	Size/Model
Weston 2000 Series	231

Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Shallow Core Magnet Rectifier
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating

Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: Steel top and bottom with valox polyester frame and acrylic window.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Lance pointer — black
Scale Length: 2.6" (66 mm)
Net Weight: 9 oz. (0.26 kg)

Ordering Information

AC Current Meters Shallow-Core Magnet Rectifier Type

Range	Approx. Impedance (ohms) @ 60Hz	Catalog Number
0-5 amps	Internal transformer burden: 0.5 VA	16871

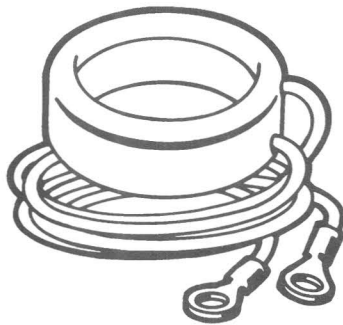
Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
DC Voltage	C	113-114
AC Voltage	C	51-52
DC Current	C	83-84

Accessories

Donut Transformer



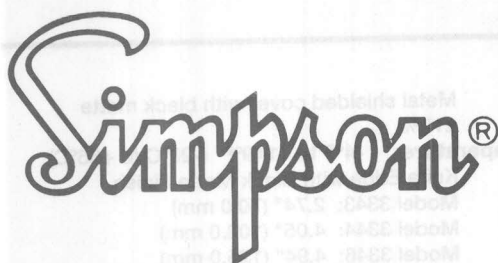
A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Engineers Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

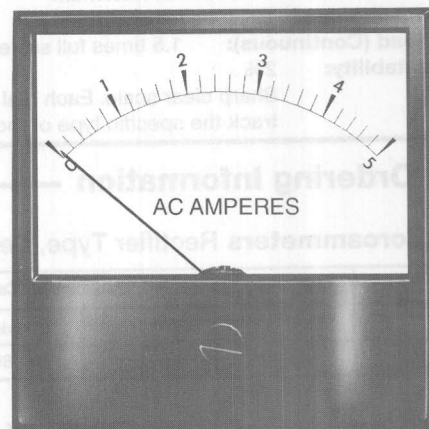


AC Current Meters

Rugged Seal Style

- **Rugged Metal Case for Rigorous Environments**
- **O-Ring Sealed Zero Adjust and Electrical Termination**
- **Commercially Sealed Moisture and Dust Proof**
- **Three Sizes: 3-1/2", 4-1/2", 4x6"**
- **Calibration Not Affected by Steel Panel Mounting**

Specifically designed for harsh environments, Simpson's Rugged Seal panel meters are ideal for use in field test equipment or wherever rigorous environmental conditions are encountered. This line of panel meters offer a stylish look with its black metal case and clear glass window. The metal case gives complete magnetic isolation which is especially important in steel panel mounting where stray magnetic fields can induce errors in your reading. In addition, each meter is moisture, dirt, and dustproof. For applications where wash down of control panels is necessary, the Rugged Seal meters are splash proof and offer excellent resistance to water. For added environmental protection, both zero adjust and electrical terminals are O-ring sealed. The Rugged Seal meters are available in three convenient sizes: 3-1/2", 4-1/2", and 4x6".

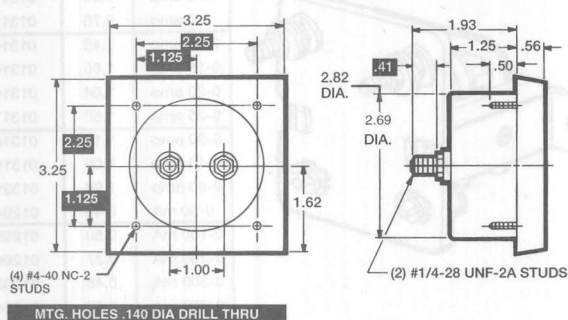


Model Number	Size	Meter Movement
3343	3-1/2"	Annular-Rectifier
3344	4-1/2"	Annular-Rectifier
3346	4x6"	Annular-Rectifier

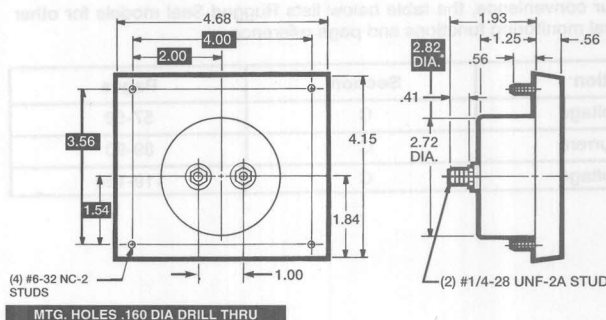
All AC units have rectifier type, self-shielding meter movements with pivot and jewel suspension and offer $\pm 3\%$ of full scale accuracy. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

Dimensions and Compatibility

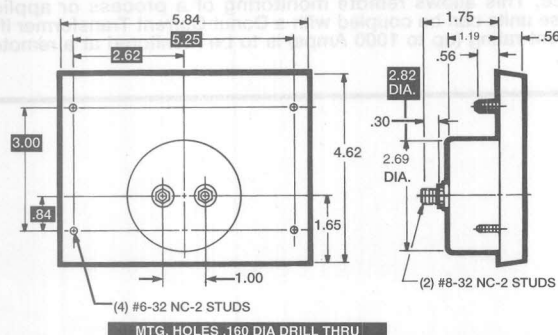
3-1/2"-Model 3343



4-1/2"-Model 3344



4X6"-Model 3346



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec K Series	K3S	K4S

Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Annular Rectifier, Self-shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: Metal shielded cover with black matte
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Knife Edge with Black Matte Finish
Scale Length: Model 3343: 2.74" (70.0 mm)
 Model 3344: 4.05" (103.0 mm)
 Model 3346: 4.94" (125.0 mm)
Net Weight: Model 3343: 12 ozs (0.340 Kg)
 Model 3344: 17 ozs (0.48 Kg)
 Model 3346: 19 ozs (0.54 Kg)

Ordering Information

AC Microammeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		3-1/2" Model 3343	4-1/2" Model 3344	4x6" Model 3346
0-100	4,000	< >	16185	< >

AC Milliammeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		3-1/2" Model 3343	4-1/2" Model 3344	4x6" Model 3346
0-1	600	16085	16180	16275

AC Current Meters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		3-1/2" Model 3343	4-1/2" Model 3344	4x6" Model 3346
0-5	0.5 VA max.*	16080	16175	16270

* Internal transformer burden.
 < > Available on special order.

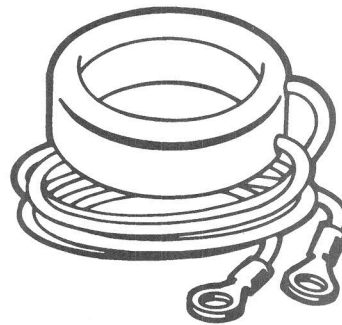
Function Reference Table

For your convenience, the table below lists Rugged Seal models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	57-58
DC Current	C	89-90
DC Voltage	C	119-120

Accessories

Donut Transformer

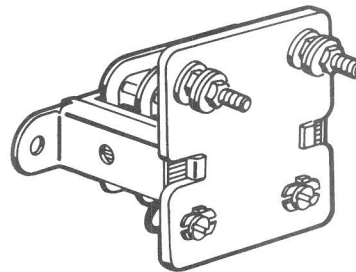


Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

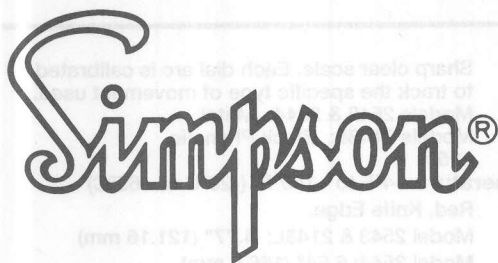
Model 186 Current Transformer



Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

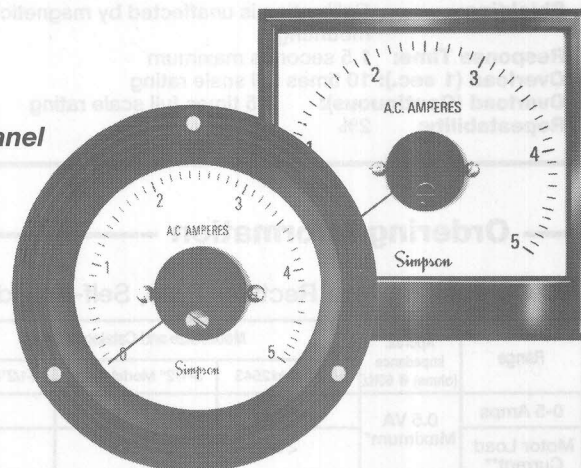
Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.



AC Current Meters

250° Long Style

- More Than Double the Scale Length
- Phenolic and Shielded Metal Cases
- Round or Rectangular Case Styles
- Zero Adjust From Front Panel
- Two Sizes: 3-1/2", 4-1/2"
- External Zero Adjust



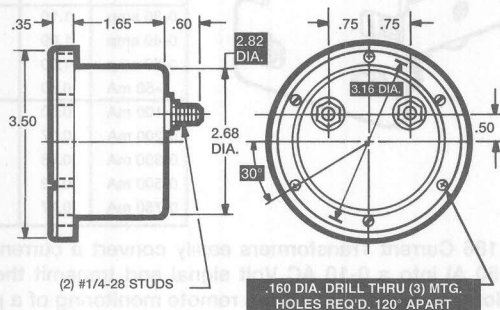
Model Number	Size	Meter Movement
2543	3-1/2"	Rectifier
2143L	3-1/2"	Rectifier
2544	4-1/2"	Rectifier

Look to the 250° Long Scale analog meters for a full 250° readability that provides more than double the scale length of the standard 90° or 100° movements. Simpson's 250° panel meters are designed for applications that require high-resolution readings all in a compact and attractive design. They are rectifier type, self-shielded, moving coil instruments with non-magnetic pivots and spring-backed jewels. The movement construction allows the meter to be mounted on steel panels. These easy-to-read meters are available in either sealed round metal or in molded square phenolic cases with glass windows. The zero adjust is conveniently located on the external front portion of the meter. Two different standard sizes of 3-1/2" and

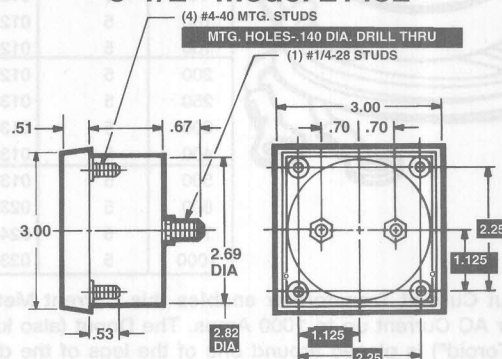
4-1/2" are available to measure various current ranges. In addition, this style meter can be ordered to measure motor load current. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

Dimensions

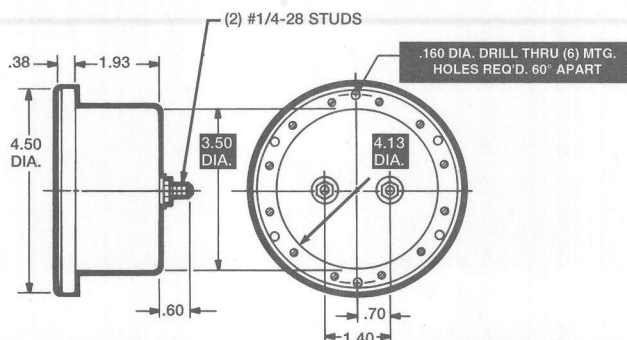
3-1/2"-Model 2543



3-1/2"-Model 2143L



4-1/2"-Model 2544



Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Rectifier type
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: Models 2543 & 2544: Metal
 Models 2143L: Black Phenolic
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Red, Knife Edge.
Scale Length: Model 2543 & 2143L: 4.77" (121.16 mm)
 Model 2544: 6.54" (166.0 mm)
Net Weight: Models 2543 & 2143L: 8 oz (230 g)
 Model 2544: 9 oz (260 g)

Ordering Information

AC Current Meters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		3-1/2" Model 2543	3-1/2" Model 2143L	4-1/2" Model 2544
0-5 Amps	0.5 VA Maximum*	< >	17918	< >
Motor Load Current**		< >	17719	< >

* Internal transformer burden.
 **0-156%MA for Lead Current
 < > Available on special order.

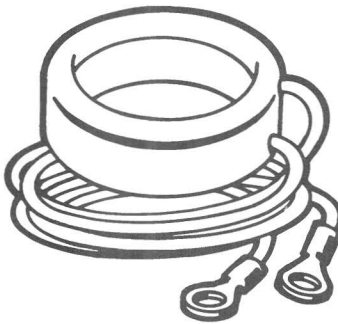
Function Reference Table

For your convenience, the table below lists 250° Long style models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	61-62
DC Current	C	91-92
DC Voltage	C	121-122

Accessories

Donut Transformer

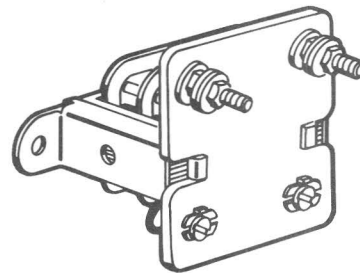


Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

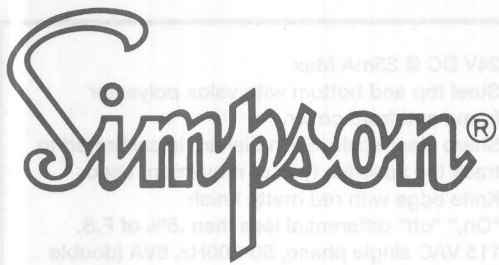
Model 186 Current Transformer



Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307

Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.



AC Current Meters

Edgewise Controller



- $\pm 3\%$ Standard Accuracy
- Integral Mounting Lock for Easy Installation
- Double or Single Setpoints
- Mode Indication Lamps
- Stacked or Individually Mounted
- Pivot and Jewel Suspension
- Optional Relay Kit or Triac Module
- Horizontal Mounting (Vertical Mounting On Special Order)
- Control Switching Within 1.0% of Setpoints

Model Number	Size	Setpoint/Range	Meter Movement
3643XO	3-1/2"	Single or Double 0-5 AC	Shallow Core Magnet

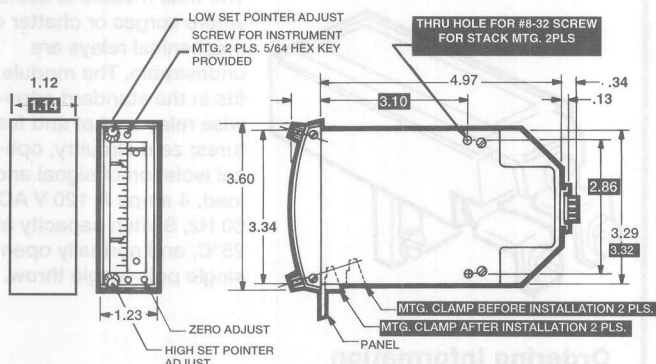
Simpson's Model 3643XO Edgewise Controllers offer an attractive and accurate analog display in a minimum of panel space. The controller provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility and unsurpassed stability. Mounting clips are attached to the controller housing and then tightened against panel without using screws for simplified panel mounting. A unique Simpson self-shielding core magnet provides ± 3 percent F.S. standard accuracy for either horizontal or vertical scale orientations. Each

unit can be stacked or mounted individually. Model 3643XO controller features single or double setpoints with mode indication lamps. DPDT relay or triac (sold separately) are available for each setpoint. The single setpoint provides 0-100% adjustability while the dual setpoint units offer 0-98% for low and 2-100% high. All models can be set within 2° of each other for accurate measuring capability. Each knob is removable to prevent tampering. Control switching is within 1.0% of setpoints and dead band is less than 0.5% of full scale.

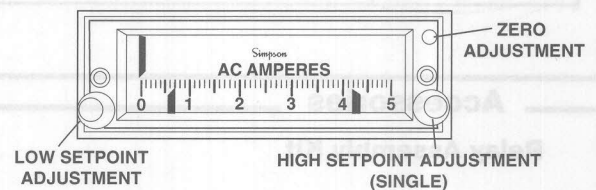
Dimensions

3-1/2"-Model 3643XO

1 = Panel Meter Cut-out Dimensions



Calibration and Adjustments



Setpoint Adjustment

Low and High Setpoint- To adjust setpoint for low range, turn adjustment knob located on lower left portion of front panel. High range adjustment is made by turning the adjustment knob on lower right hand portion of front panel.

Zero Adjustment

For zero adjustment, simply remove the knob used for setpoint adjustment and place in slot on the upper right portion of the front panel.

Mode Indication Lamps

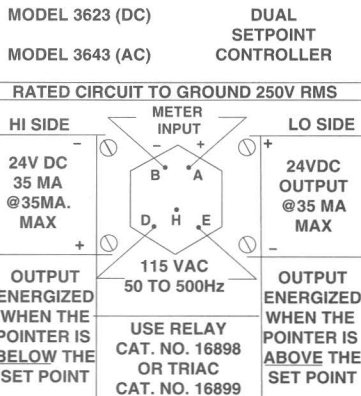
For control applications, when the measurement falls below the lower set point or above the high setpoint the corresponding alarm output is activated and the red mode indication lamp lights up. The light on the left side of the dial face represents the low setpoint while the one on the right represents the high.

Specifications

Accuracy: $\pm 3\%$ F.S.
Switching Accuracy: Within 1% F.S. of set point indication
Movement: Shallow core magnet
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Repeatability: 2%
Shielding: Calibration is unaffected by magnetic panel mounting
Single Set Point: High limit standard, adjustable 0-100% F.S.
Double Set Point: Low 0-98% of F.S.; high limit 2-100% of F.S. Set points are adjustable within 2°

Output: 24V DC @ 35mA Max
Case: Steel top and bottom with valox polyester frame and front cover.
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Pointer: Knife edge with red matte finish
Dead Band: "On," "off" differential less than .5% of F.S.
Input Power: 115 VAC single phase, 50-500Hz. 6VA (double set point), 4VA (single set point).
Storage Temperature: -40°F to 140°F (-40°C to +60°C)
Operating Temperature: +41°F to 122°F (+5°C to +50°C)
Scale Length: 2.6" (66 mm)
Weight: 10 ozs. (0.28g)

Connections



Input Signal: Input to be monitored is connected to pins A(+) and B(-)

Supply Power: The power source (115 VAC, 50 to 500Hz) for meter operation is connected to pins D and E.

Output: The model 3643 supplies a 24VDC@35mA switching current for each relay (cat. #16898) or triac switch module (cat #16899). Connect the output to the (+) and (-) terminals on the back of the controller as outlined on the diagram.

Ordering Information

Range	Model/Size & Catalog Number
	3-1/2" Model 3643XO
0-5 A AC SSP	19323
0-5 A AC DSP	19324

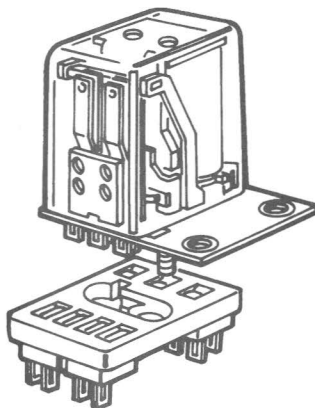
Function Reference Table

For your convenience, the table below lists Edgewise Controller models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	63-64
DC Current	C	93-94
DC Voltage	C	123-124

Accessories

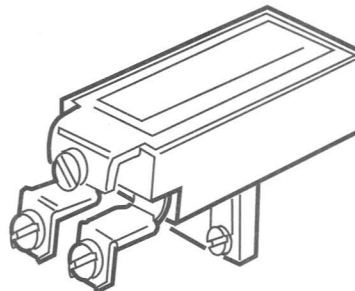
Relay Assembly Kit



This Relay Assembly Kit gives the Edgewise Controller the capability to switch a 5 amp load for a setpoint setting. The kit contains one DPDT Relay and Socket Type connector, rated at 5 Amperes resistive load at 120 VAC for each relay pole. The relay can be wired for automatic or manual reset operation. Relay is factory wired for automatic reset operation. The mechanical life of the relay is 1,000,000 operations at rated load.

Refer to Accessory Section for Model 186 or Donut Transformer Applications

Triac Switch Module



The triac module is useful where surges or chatter of mechanical relays are undesirable. The module fits in the standard edge-wise relay socket and features: zero circuitry, optical isolation of signal and load, 4 amps @ 120 V AC 60 Hz, Switch capacity at 25°C, and normally open single pole-single throw.

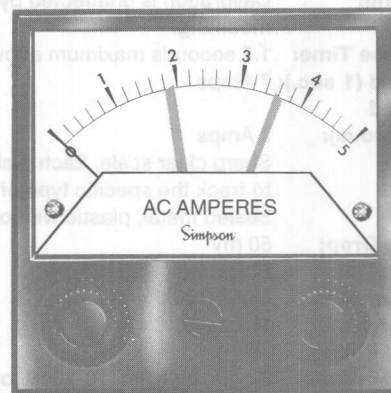
Ordering Information

Description	Catalog Number
Relay Assembly kit	16898
Triac Switch Module	16899



AC Current Meters

Rugged Seal Controller



Model Number	Size	Meter Movement
3343AIXA	3-1/2"	Annular-Rectifier
3344AIXA	4-1/2"	Annular-Rectifier
3346AIXA	4x6"	Annular-Rectifier

- **Commercially Sealed Moisture and Dust Proof**
- **Rugged Metal Case for Rigorous Environments**
- **Single and Dual Set Points**
- **Wide Variety of Control, Alarm and Limit Use**
- **Calibration Not Affected by Steel Panel Mounting**
- **Three Sizes: 3-1/2", 4-1/2", 4x6"**

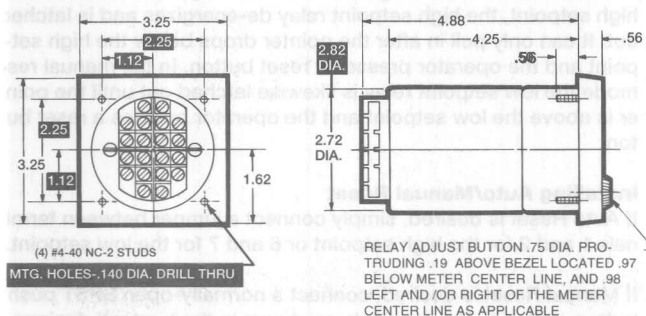
The 33 Series instruments offer a wide variety of applications in control, alarm and limit use. Photo conductor sensing eliminates all interference with the indicating meter. These relays incorporate an amplifier input which drives a rugged high torque pivot and jewel or taut-band meter. Metal cased "Rugged Seal" construction withstands rigorous environmental conditions. The metal cover with a drawn steel rear case (plated) gives complete magnetic isolation for steel panel mounting. In addition, each meter is moisture, dust, and dirt proof and recommended for use in wash down areas. Fail safe circuitry opens output relays in the event of power failure. Three different sizes of 3-1/2", 4-1/2", and 4x6" are available in both single and dual setpoint models.

High-gain transistor switch circuit provides accurate switching with a "dead band" of no more than 0.5% of full scale. All AC current units offer $\pm 3\%$ of full scale accuracy. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

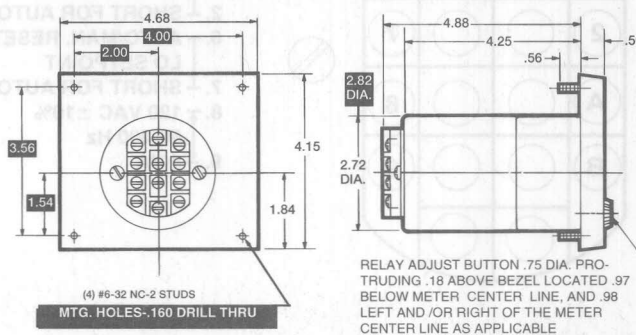
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

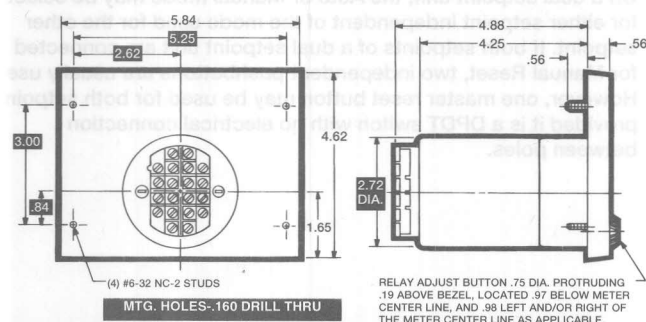
3-1/2"-Model 3343AIXA



4-1/2"-Model 3344AIXA



4x6"-Model 3346



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec		
YS Series	YS3	YS4
YD Series	YD3	YD4

Scale Length: 4.05" (103.0mm)
Net Weight: 17 ozs (0.48kg)
Control Point(s):
Adjustments: Single, high limit, 0-100% of arc; double, low limit 0-95% of arc; high limit 5-100% of arc. Adjustable to within 4° of each other.

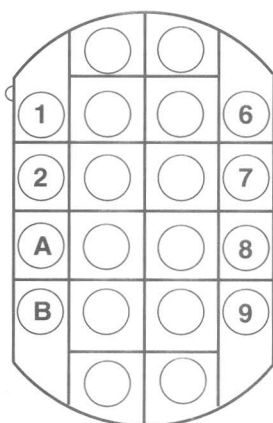
Temperature: 41°F to 122°F (+5°C to +50°C)

Circuit-to-Ground

Voltage: 250V rms maximum.

Wiring Diagram

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
 B. - SIGNAL INPUT
 1. AUTO/MAN. RESET HI SETPOINT
 2. SHORT FOR AUTO
 6. AUTO/MAN. RESET LO SETPOINT
 7. SHORT FOR AUTO
 8. 120 VAC $\pm 10\%$
 50-400 Hz
 9. 4 VA

Input Signal: Input to be monitored is connected to terminals A(+) and B (-). The signal input accepts 5 amperes AC full scale.

Input Power: The power source used is 120VAC $\pm 10\%$, 50 to 400 Hz. The power requirement is nominally 5VA. Connect power source to terminals 8 and 9.

Auto/Manual Reset

There are two modes of relay logic available in the 33 Series: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is de-energized when the pointer exceeds the high setpoint, and is automatically energized when the pointer again drops below the setpoint. The low setpoint relay is de-energized when the pointer drops below the low setpoint, and is automatically energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay de-energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other setpoint. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent pushbuttons are usually used. However, one master reset button may be used for both setpoints provided it is a DPDT switch with no electrical connection between poles.

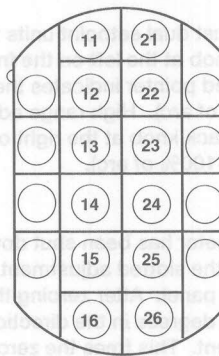
Relays

Relays can be used to "turn on" or "turn off" power to a process that Simpson's Rugged Seal controller is monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to change in condition in the process. The controller's relays for both single and dual setpoint meters are double pole, double throw relays.

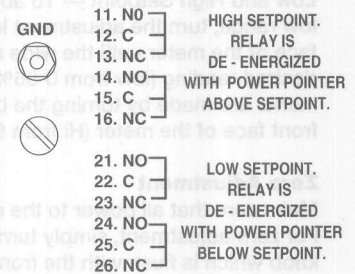
High Setpoint: The high setpoint relay contacts (on both single and dual setpoint meters) are de-energized when the pointer is above the desired setpoint. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts or common. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (appear on dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminals 21 and 24. Terminals 22 and 25 are moving contacts or common. Use terminals 23 and 26 for normally closed relays.

REAR VIEW OF HEADER

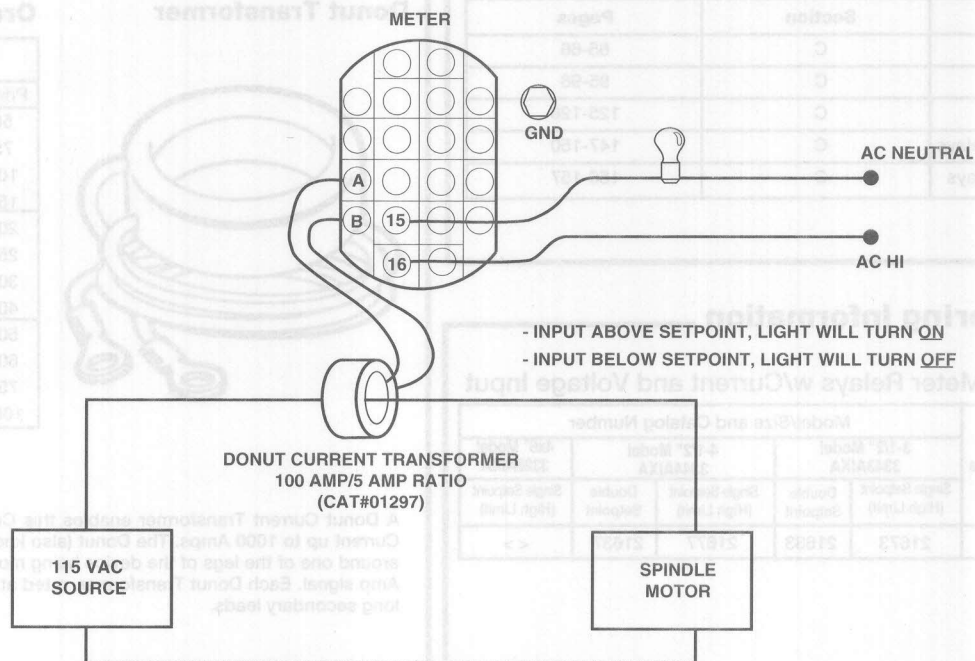


TERMINAL DESIGNATIONS



RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Application Example



A machine shop manager is interested in measuring the current draw of a 115 VAC spindle motor of a drill press. If the current draw is above 90 amperes the motor could burn up thus disrupting the drill press operation.

The 33 Series AC current controller is configured by simply connecting an external donut current transformer (Toroid) to Terminal A (+) and Terminal B (-). The current carrying wire to be sensed is passed through the center of the current transformer (100 amp/5 amp ratio). The controller contains a special dial that reads 0-100 AC amp full scale with an input of 0-5 amperes.

The machine shop manager utilizes the high setpoint relay and adjusts it to 90 amperes. If the current goes above the setpoint the relay will de-energize and will "turn on" a light, alerting the operator to a change in condition in the process.

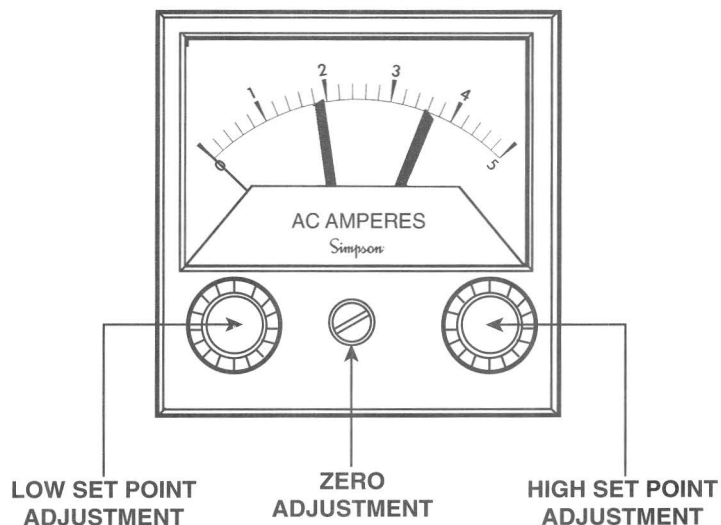
Adjustments

Setpoint Adjustment

Low and High Setpoint — To adjust dual setpoint units for low range, turn the adjustment knob at the left on the front face of the meter until the wide red pointer indicates the desired reading (low from 0-95% of arc). High range adjustments are made by turning the black knob at the right on the front face of the meter (Hi from 5-100% of arc).

Zero Adjustment

Make sure that all power to the meter has been shut down. For zero adjustment, simply turn the slotted adjustment knob which is flush with the front panel. After zeroing the pointer, turn the knob back a few degrees in the direction opposite from your final adjustment. This frees the zero adjust from the pointer mechanism.



Function Reference Table

For your convenience, the table below lists Rugged Seal Controller models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	65-66
DC Current	C	95-98
DC Voltage	C	125-126
Temperature Relays	C	147-150
Motor Load Relays	C	156-157

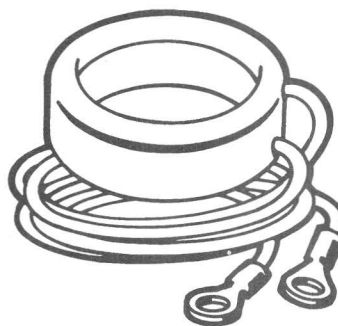
Ordering Information

33 Series Meter Relays w/Current and Voltage Input

Ranges	Approx. Impedance (ohms)	Model/Size and Catalog Number					
		3-1/2" Model 3343AIXA		4-1/2" Model 3344AIXA		4x6" Model 3326AIXA	
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	
0-5	.01	21673	21633	21677	21637	< >	

Accessories

Donut Transformer



Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Simpson®

AC Voltage Meters



Simpson AC Voltage meters are available in many standard and custom ranges. Choose from 1-1/2", 2-1/2", 3-1/2", 4-1/2" and 4x6" sizes. Case styles include Century, Designer, Tru-View, Wide-View, Round and Rectangular, Rugged Seal, Segmental, 250° Long Scale, Edgewise Barrel, Stackable Edgewise, and 3-1/2" Edgewise.

While the Simpson Family of AC voltage meters all measure AC voltage, they are not exactly alike and differ in their applications. The 250° Long Scale meter is designed for applications that require high accuracy readings. 250° panel meters provide more than double the scale length of the standard models. When panel designs require making every square inch count or when weight-saving is important, Edgewise Barrel type or Stackable Edgewise meters solve these design problems. A self-shielding core magnet movement, unique to the Edgewise Stackable panel meter, eliminates the protruding barrel which is prevalent in other Edgewise meters.

The Wide-View features modern styling with a durable, open-faced plastic cover for wide-angle readability. Round and Rectangular, Designer and Century offer easy reading, attractive design and choice of case styles. Tru-View models feature a modern, clear acrylic front and clean, open scale to update your panel design. Rugged Seal panel meters are ideal where rigorous environments are encountered. They are completely sealed, commercially ruggedized, metal cased and magnetically shielded.

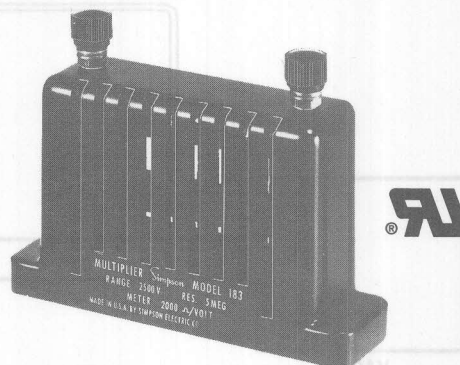
And finally, Segmental meters make it possible to measure very small changes in input conditions. The significant portion of the overall voltage range is expanded to cover the full scale length. Thus, only that segment of the range that is important appears.

AC Voltage Meters offer choice of iron-vane or rectifier movement types. Rectifier type movements are generally selected when high sensitivity and relatively wide frequency response are required. Such meters are not suitable for measurements of non-sinusoidal wave-

forms. Moving iron-vane instruments are used for non-sinusoidal waveforms, and where economy is essential. Their frequency response is flat only from 25-125cps and sensitivity is limited. Generally, AC Voltage Meters are self-contained up to 500 volts. However, many applications require voltage measurement above 500 volts. To accommodate applications that require higher voltage monitoring, an external multiplier is installed in series with the meter. Together they are arranged in parallel with the load and source.

A multiplier enables an AC Voltage Meter with an iron-vane type meter movement to monitor a high voltage measurement by dropping the voltage supplied to the AC voltage meter to 150 volts.

Model 183 Multiplier Series



Model 183 external multiplier enables a voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Several Simpson AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Figure 3. AC Voltage Meter with Multiplier Wiring Diagram

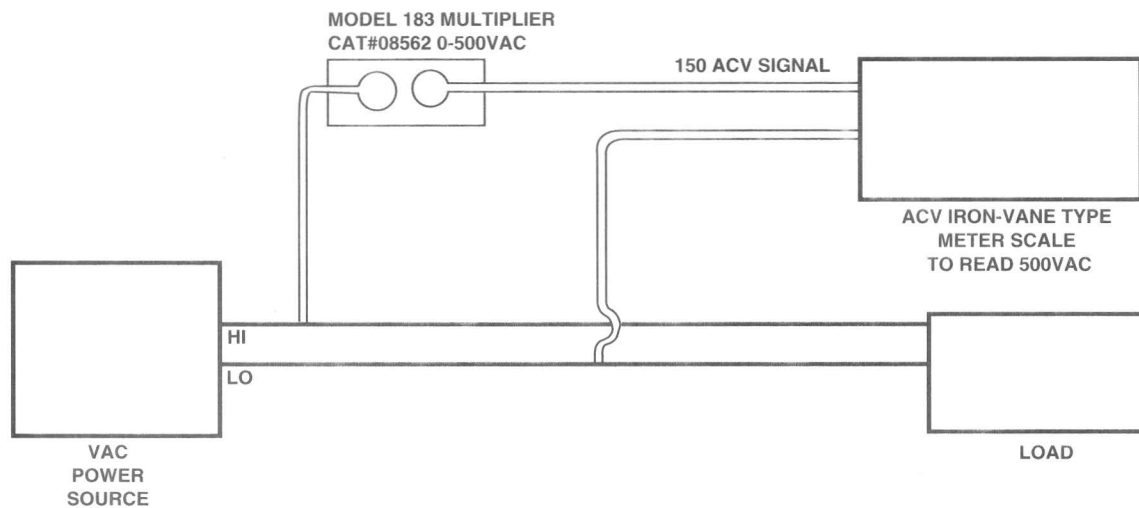
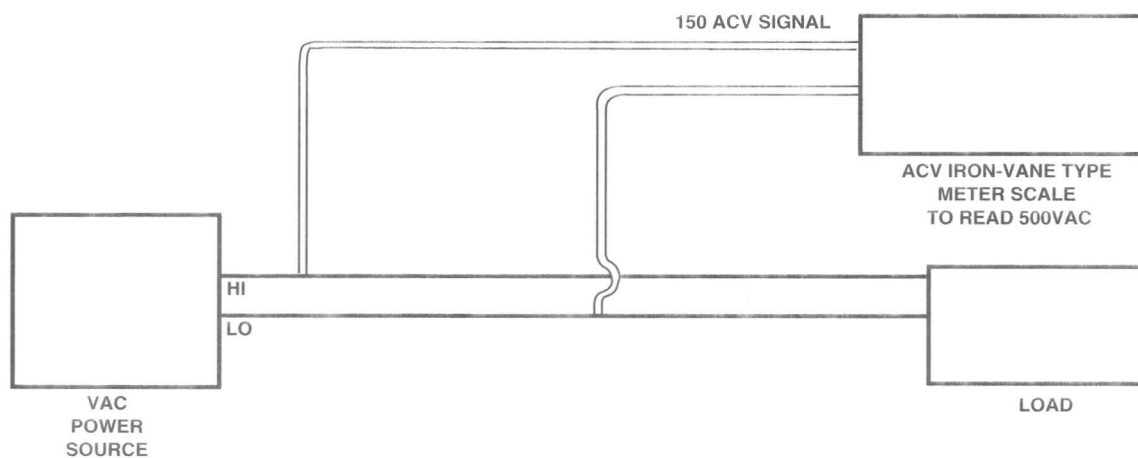


Figure 4. AC Voltage Meter (Self-Contained) Wiring Diagram



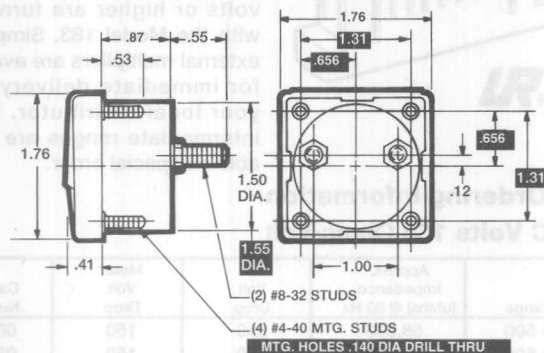
Molded in a black phenolic case, this distinctive style meter with clear acrylic window provides wide angle visibility and can either be surface mounted or bezel mounted (semi-flush mount) with one of Simpson's Wide-Vue bezel kits. Available in four standard sizes of 1-1/2", 2-1/2", 3-1/2", and 4-1/2", the Wide-Vue is ideal for reliable measurement of AC voltage ranges between 5 and 500 volts. In addition, Simpson offers dual range units in 3-1/2 and 4-1/2 inch sizes that measure both 0-150 volts and 0-5 amps on one scale. Voltage inputs of 500 volts or higher must be used with the supplied external multiplier. Iron-vane units have $\pm 2\%$ F.S. ($\pm 3\%$ F.S. for rectifier) accuracy and meet American National Standards Institute specifica-

tion ANSI C39.1. Also available is an illumination kit, for 4-1/2" Wide-Vue meters, which includes two bulb and socket assemblies with mounting parts.

Model Number	Size	Meter Movement
1214	1-1/2"	Rectifier
1247/1257	2-1/2"	Rectifier/Iron-Vane
1347/1357	3-1/2"	Rectifier/Iron-Vane
1349/1359	4-1/2"	Rectifier/Iron-Vane

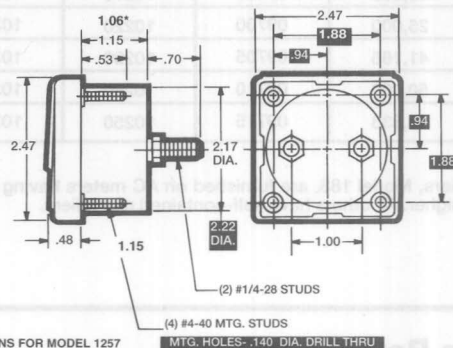
Dimensions and Compatibility

1-1/2"-Model 1214



1 = Panel Meter Cut-out Dimensions

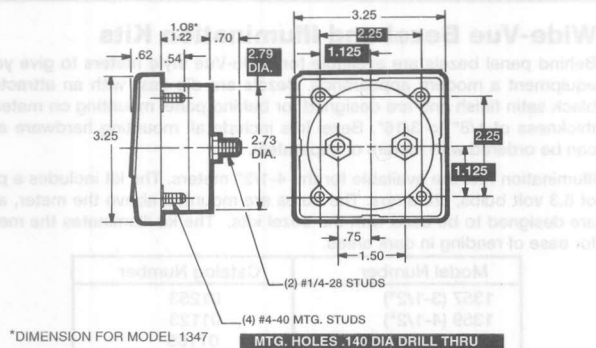
2-1/2"-Models 1247 & 1257



*DIMENSIONS FOR MODEL 1257

MTG. HOLES-.140 DIA. DRILL THRU

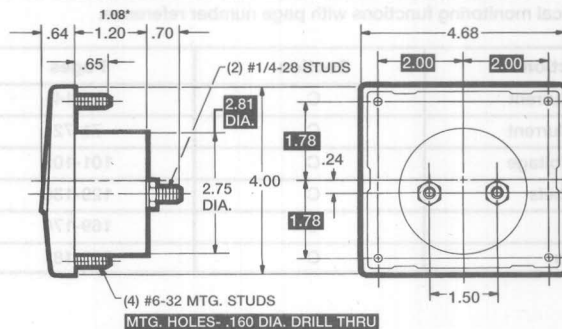
3-1/2"-Models 1347 & 1357



*DIMENSION FOR MODEL 1347

MTG. HOLES-.140 DIA. DRILL THRU

4-1/2"-Models 1349 & 1359



*DIMENSION FOR MODEL 1349

Specifications

Accuracy:	±2% F.S. (Iron-Vane); ±3% F.S. (Rectifier)
Movement:	Models 1214,1247,1347,1349: Annular-Rectifier. Models 1257, 1357,1359: Iron-Vane, magnetically damped
Suspension:	Pivot and Jewel
Tracking:	±2% F.S.
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	3%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black plastic.
Pointer:	Spade pointer, with black matte finish. Model 1214 (lance pointer black matt finish)
Scale Length:	Model 1214: 1.50" (38.1mm) Models 1247, 1257: 2.30" (58.4mm) Models 1347, 1357: 3.14" (79.9mm) Models 1349, 1359: 3.93" (100.0mm)
Net Weight:	Models 1214: 2 oz(0.06kg) & 1247: 6oz(0.17kg) Models 1257:4 oz.(0.11kg) & 1347: 8oz(0.23kg) Models 1359:5 oz.(0.14kg) & 1349: 9oz(0.26kg)

Ordering Information

AC Voltage Meters Rectifier Type Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number			
		1-1/2" Model 1214	2-1/2" Model 1247	3-1/2" Model 1347	4-1/2" Model 1349
0-5	2000 ohms per volt	10011	10015	10020	10090
0-10		10012	10016	10030	10100
0-15		< >	< >	10040	10110
0-50		< >	< >	10050	10120
0-150		10013	10017	10060	10130
0-300		10014	10018	10070	10140

AC Voltage Meters Iron Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 1257	3-1/2" Model 1357	4-1/2" Model 1359
0-5	33	< >	10160	10260
0-10	133	09670	10170	10270
0-15	300	09675	10180	10280
0-25	833	09680	10190	10290
0-50	3,333	09690	10200	10300
0-100	16,333	09695	10210	10310
0-150	25,000	09700	10220	10320
0-250	41,166	09705	10230	10330
0-300	50,000	09710	10240	10340
0-500†	83,333	09715	10250	10350

†External multipliers, Model 183, are furnished on AC meters having a range of 500 volts or higher. All others have self-contained multipliers.

Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	13-14
DC Current	C	71-72
DC Voltage	C	101-102
Decibels	C	129-130
VU	C	169-170
Watts	C	180-181

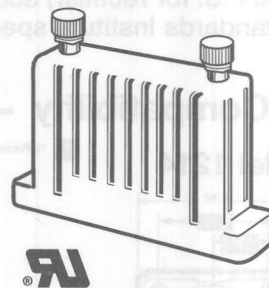
Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton			
Celebrity	223	225	227
Challenge	362	363	364
Clearvut	233	235	237
Hoyt	3126	3136	3146
Modutec			
S Series	2S-	3S-	4S-
PB Series	2PB*	3PB*	4PB
Triplett G Series	230-G	330-G	430-G
Weston 2000 Series	2024	2034	2044
Yokogawa			
Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1
Horizon	251-210	251-310	251-410

*Modutec uses a three-stud mount.

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables an iron-vane type voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

Ordering Information

AC Volts 166 Ohms/Volt

Range	Approx. Impedance (ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

Wide-Vue Bezel and Illumination Kits

Behind panel bezels are available for Wide-Vue style meters to give your equipment a modern appearance. Bezel kits include all mounting hardware and can be ordered with meters or separately.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas.

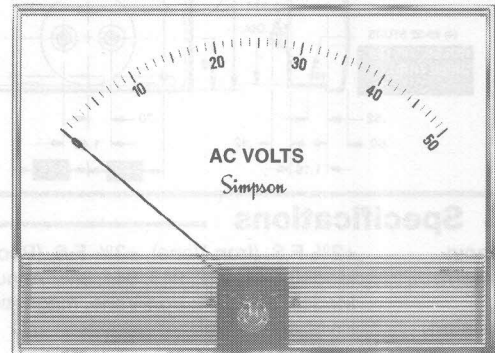
Model Number	Catalog Number
1357 (3-1/2")	01253
1359 (4-1/2")	01123
1359 Illumination Kit	01165



AC Voltage Meters

Tru-View Style

- Clear, Acrylic Windows
- Optional Bezel Kits
- Special Colored Scales or Logos Available
- $\pm 2\%$ Full Scale Accuracy ($\pm 3\%$ F.S. For Rectifier)
- Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2", and 4x6"



Simpson's Tru-View family of analog panel meters offer a modern, clear acrylic front lens and clean, open scale to update your panel design. Tru-View panel meters provide reliable measurement of AC volts with five popular sizes to choose from. Simpson AC meters measuring voltage inputs between 1 and 300 volts are self-contained units. Voltage inputs of 500 volts or higher must be used with an external multiplier. Iron-vane units have $\pm 2\%$ F.S. ($\pm 3\%$ F.S. for rectifier) accuracy and meet American National Standards Institute specification ANSI C39.1. Attractive, black satin, die cast bezels are available in 3-1/2 and 4-1/2 inch sizes for behind panel mounting. The movement construc-

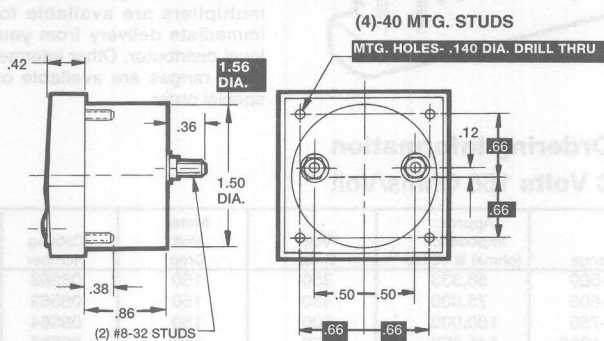
tion provides excellent readability under severe conditions where shock and vibration would destroy or limit the life of a standard movement.

Model Number	Size	Meter Movement
941	1-1/2"	Rectifier
942	2-1/2"	Rectifier
943	3-1/2"	Rectifier
953	3-1/2"	Iron-Vane
944	4-1/2"	Rectifier
954	4-1/2"	Iron-Vane
946	4x6"	Rectifier

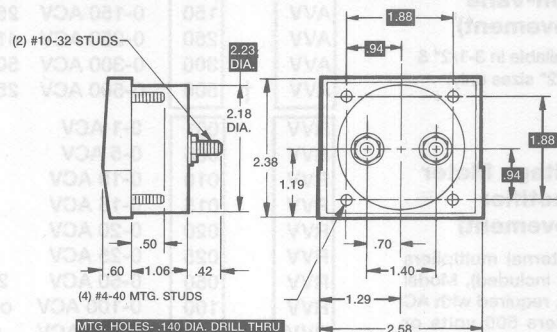
Dimensions and Compatibility

1-1/2"-Models 941

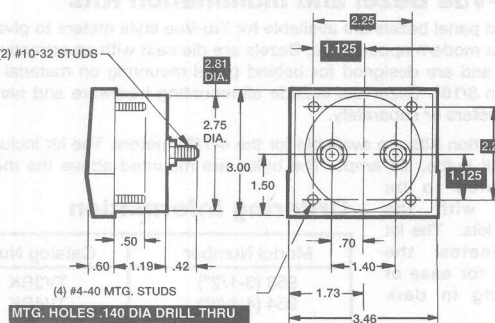
1 = Panel Meter Cut-out Dimensions



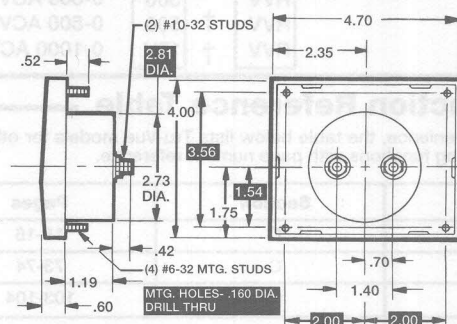
2-1/2"-Models 942



3-1/2"-Models 943 & 953

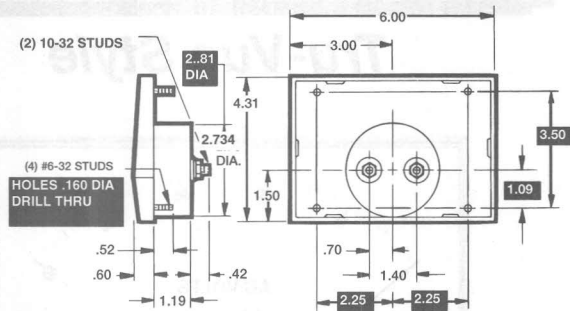


4-1/2"-Models 944 & 954



Dimensions and Compatibility

4x6"-Models 926 & 946



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton			
Celebrity	223	225	227
Challenge	362	363	364
Clearvu	233	235	237
Hoyt			
3100	3126	3136	3146
Custom	2026	2036	2046
Window	3126W	3136W	3146W
Modutec			
S Series	2S-	3S-	4S-
PB Series	2PB*	3PB*	4PB
Triplett G Series	230-G	330-G	430-G
Weston 2000 Series	2024	2034	2044
Yokogawa Horizon	251-210	251-310	251-410

*Modutec uses a three-stud mount.

Specifications

Accuracy: $\pm 2\%$ F.S. (Iron-Vane), $\pm 3\%$ F.S. (Rectifier)
Movement: Models 941, 942, 943, 944, 946: Annular-Rectifier
 Models 953, 954: Iron-Vane, magnetically damped
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Repeatability: 2%
Shielding: Calibration unaffected by stray magnetic field or mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating.
Overload (Continuous): 1.5 times full scale rating
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Resistance: $\pm 15\%$
Case: Plastic
Pointer: Knife edge, black finish
Scale Length: Model 941: 1.56" (39.62 mm); Model 942: 2.40" (60.96 mm) Model 943: 3.27" (83.06 mm) Model 953: 2.94" (74.68 mm) Model 944: 3.92" (99.57 mm) Model 954: 3.53" (89.66 mm) Model 946: 5.45" (138.43 mm)
Net Weight: Model 941: 1.5 oz. (0.04 kg); Model 942: 4 oz. (0.11 kg); Model 943 & 953: 6 oz. (0.17 kg); Models 944 & 954: 8 oz. (0.23 kg); Model 946: 12 oz. (0.34 kg)

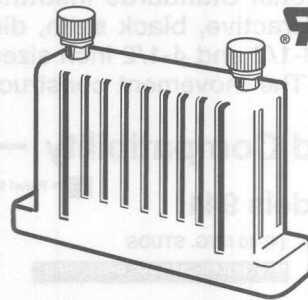
Ordering Information

SIZE	FUNCTION	RANGE	$\approx$ ohms
1 1-1/2"			
2 2-1/2"			
3 3-1/2"			
4 4-1/2"			
6 4 x 6"			
Voltage Meter (Iron-Vane Movement)			
(Available in 3-1/2" & 4-1/2" sizes only)			
	AVV	005	0-5 ACV 33
	AVV	010	0-10 ACV 133
	AVV	015	0-15 ACV 300
	AVV	025	0-25 ACV 833
	AVV	050	0-50 ACV 3333
	AVV	100	0-100 ACV 16666
	AVV	150	0-150 ACV 25000
	AVV	250	0-250 ACV 41166
	AVV	300	0-300 ACV 50000
	AVV	500	0-500 ACV 25000
	RVV	001	0-1 ACV
	RVV	005	0-5 ACV
	RVV	010	0-10 ACV
	RVV	015	0-15 ACV
	RVV	020	0-20 ACV
	RVV	025	0-25 ACV All
	RVV	050	0-50 ACV 2000
	RVV	100	0-100 ACV ohms
	RVV	150	0-150 ACV per
	RVV	200	0-200 ACV volt
	RVV	250	0-250 ACV
	RVV	300	0-300 ACV
	RVV	500	0-500 ACV
	RVV	1TH	0-1000 ACV

†External multipliers (not included), Model 183, required with AC meters 500 volts or higher.

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables an iron vane voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher require the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

Ordering Information

AC Volts 166 Ohms/Volt

Range	Approx. Impedance (ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

Tru-Vue Bezel and Illumination Kits

Behind panel bezels are available for Tru-Vue style meters to give your equipment a modern appearance. Bezel kits include all mounting hardware and can be ordered with meters or separately.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas.

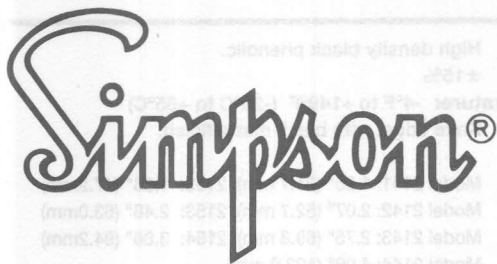
Ordering Information

Model Number	Catalog Number
953 (3-1/2")	TV3BK
954 (4-1/2")	TV4BK

Function Reference Table

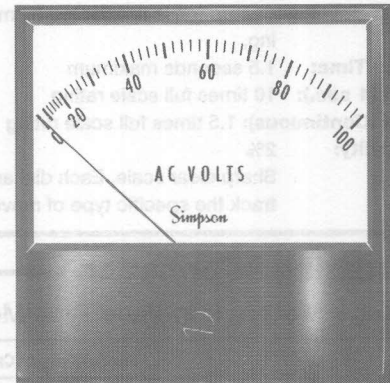
For your convenience, the table below lists Tru-Vue models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	15-16
DC Current	C	73-74
DC Voltage	C	103-104



AC Voltage Meters

Century Style



- **UL Recognized**
- **Glass Windows**
- **Phenolic Cases**
- **Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2"**
- **Rectifier or Iron-Vane Type Movements**

An attractive design for industrial or commercial applications, the Century offers maximum reliability and is accurate to $\pm 2\%$ of full scale for Iron-Vane meters and $\pm 3\%$ of full scale for rectifier type. Whether specified for an original design or as a replacement, the Century offers self-shielded movements which are unaffected by magnetic fields or panel mounting. Models are available to measure various voltage ranges up to 500 Volts AC and are calibrated at 60Hz.

These easy-to-read meters are molded in a black phenolic housing with a large glass viewing window and come in four different sizes from 1-1/2" to 4-1/2". All models offered are self-contained through 300 volts. Higher range readings require an external multiplier mentioned herein. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.



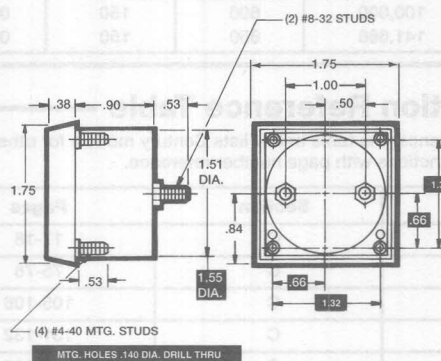
Model Number	Size	Meter Movement
2141	1-1/2"	Small Core Magnet-Rectifier
2142/2152	2-1/2"	Annular-Rectifier / Iron-Vane
2143/2153	3-1/2"	Annular-Rectifier / Iron-Vane
2144/2154	4-1/2"	Annular-Rectifier / Iron-Vane

Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton Amerint	233	235	237
Hoyt	4026	4036	4046
Modutec S Series	2S-	3S-	4S-
Triplett G Series	230-GL	330-GL	430-GL
Weston 2000 Series	2024	2034	2044
Yokogawa Horizon	251-210	251-310	251-410

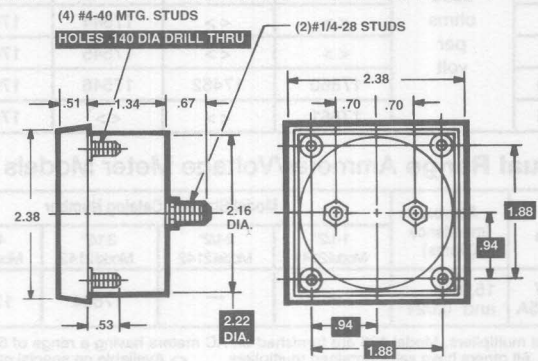
Dimensions and Compatibility

1-1/2"-Model 2141

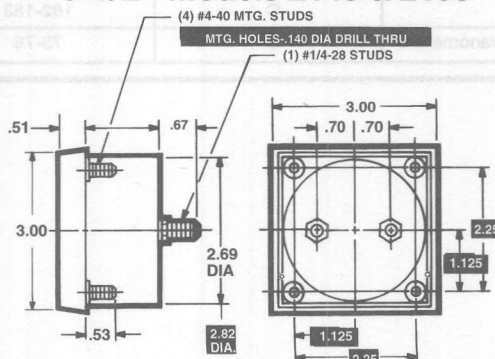


1 = Panel Meter Cut-out Dimensions

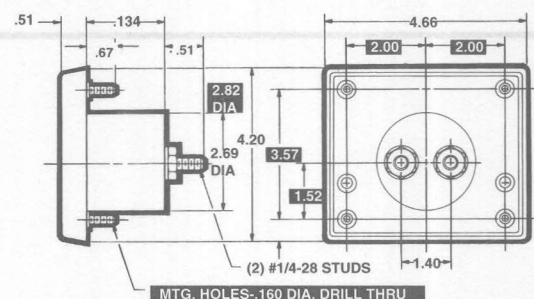
2-1/2"-Models 2142 & 2152



3-1/2"-Models 2143 & 2153



4-1/2"-Models 2144 & 2154



Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		2-1/2" Model 2152	3-1/2" Model 2153	3-1/2" Model 2154
0-5	33	< >	17725	< >
0-10	133	17685	17726	17771
0-15	300	17686	17727	17772
0-25	833	17687	17728	17773
0-50	3,333	17688	17729	17774
0-100	16,666	< >	17730	17775
0-150	25,000	17690	17731	17776
0-250	41,166	17691	17732	17777
0-300	50,000	17692	17733	17778
0-500†	83,333	< >	17734	17779

AC Voltage Meters Rectifier Type Self-Shielding

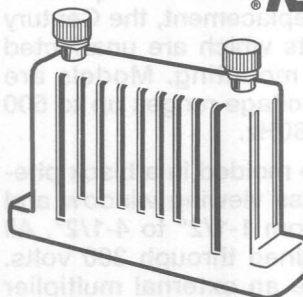
Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2141	2-1/2" Model 2142	3-1/2" Model 2143	4-1/2" Model 2144
0-5	2000 ohms per volt	17855	17460	17542	17640
0-10		17856	< >	17543	17641
0-15		< >	< >	17544	17642
0-50		< >	< >	17545	17643
0-150		17860	17462	17546	17644
0-300		17861	< >	< >	17645

AC Dual Range Ammeter/Voltage Meter Models

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2141	2-1/2" Model 2142	3-1/2" Model 2143	4-1/2" Model 2144
0-150V and 0-5A	15,030 and 0.021	—	—	17694	17739

† External multipliers, Model 183 are furnished on AC meters having a range of 500 volts or higher. All others have self-contained multipliers. < > Available on special order.

Model 183 Multiplier



The Model 183 external multiplier enables an iron-vane type voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

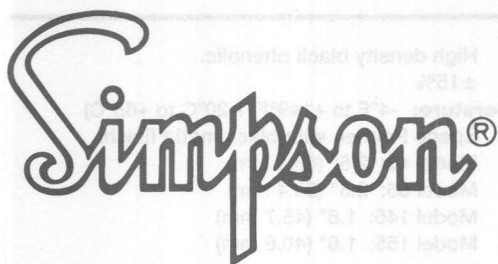
Ordering Information AC Volts 166 Ohms/Volt

Range	Approx. Impedance (Ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

Function Reference Table

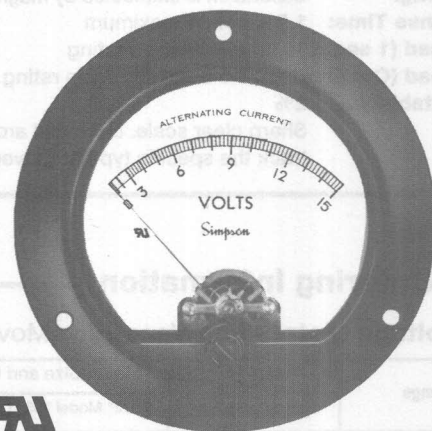
For your convenience, the table below lists Century models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	17-18
DC Current	C	75-76
DC Voltage	C	105-106
Decibels	C	131-132
RF Current	C	161-162
VU	C	171-172
Watts	C	182-183
DC Galvanometers	C	75-76



AC Voltage Meters

Round Style



■ $\pm 2\%$ Full Scale Accuracy ($\pm 3\%$ F.S. for Rectifier)

■ UL Recognized

■ Phenolic Cases and Glass Windows

■ Two Popular Sizes: 2-1/2", 3-1/2"

For industrial or commercial applications, the Round style panel meter offers maximum readability and $\pm 2\%$ full scale accuracy (3% full scale for rectifier type). With a rugged black phenolic case and glass window for optimum viewing, the Round style meter is one of our most popular choices for tough environmental applications. AC units have either iron-vane type or rectifier type movements and are calibrated at 60 Hz. Iron-vane type voltage meters have frequency range of 25 to 125 Hz (for $\pm 1\%$ deviation from value at 60 Hz). Calibration to 800 Hz is available on special order (All rectifier types have 25Hz to 10 KHz range). Two popular sizes of 2-1/2" and 3-1/2" are available to measure



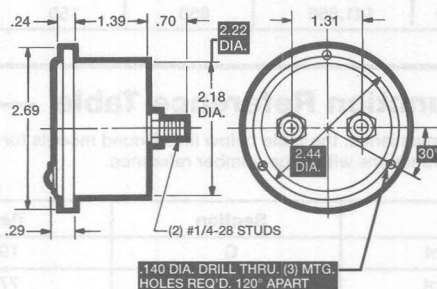
Model Number	Size	Meter Movement
155	2-1/2"	Iron-Vane
145*	2-1/2"	Rectifier
45	3-1/2"	Rectifier
55	3-1/2"	Iron-Vane

* Special order.

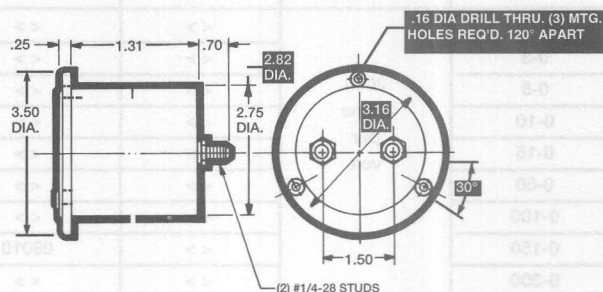
various voltage ranges. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Dimensions and Compatibility

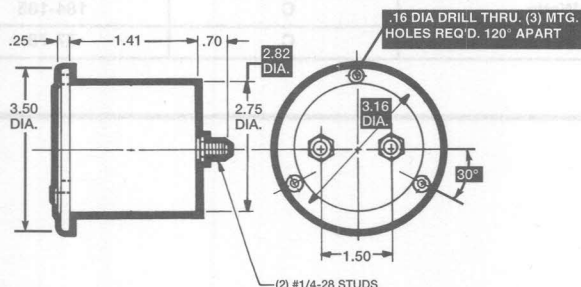
2-1/2"-Models 155 & 145



3-1/2"-Model 45



3-1/2"-Model 55



Compatibility Reference Table

Manufacturer	Size/Model	
	2-1/2"	3-1/2"
Beede	501	310
Hoyte	552	584
Triplett S Series	231-S	331-S
Weston 200 and 300	204	304

Specifications

Accuracy:	±2% F.S. (Iron-Vane); ±3% F.S. (Rectifier)
Movement:	Models 55, 155: Iron-Vane, magnetically damped Models 45, 145: Rectifier type, self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 45: 2.5" (63.5 mm) Model 55: 2.3" (58.4 mm) Model 145: 1.8" (45.7 mm) Model 155: 1.6" (40.6 mm)

Net Weight:	Model 45: 8 ozs (0.20 kg) Models 55 & 155: 5 ozs (0.14 kg) Model 145: 7 ozs (0.20 kg)
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Ordering Information

AC Voltage Meters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 155	3-1/2" Model 55
0-1.5	3	<>	<>
0-3	12	<>	<>
0-5	33	<>	08410
0-10	133	<>	08420
0-15	300	<>	08430
0-25	833	<>	08440
0-50	3,333	09290	08450
0-100	16,166	<>	08460
0-150	25,000	09310	08470
0-250	41,166	09320	08480
0-300	50,000	09330	08490
0-500	83,333	09340†	08500†
0-750	125,000	<>	08510†
0-1000	166,666	<>	<>

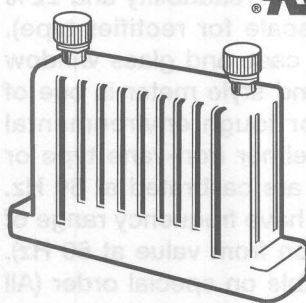
AC Voltage Meters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		2-1/2" Model 145	3-1/2" Model 45
0-1	2000 ohms per volt	<>	<>
0-3		<>	<>
0-5		<>	<>
0-10		<>	<>
0-15		<>	<>
0-50		<>	<>
0-100		<>	<>
0-150		<>	08010
0-300		<>	<>

† External multipliers, Model 183 are furnished on AC meters having a range of 500 volts or higher. All others have self-contained multipliers. <> Available on special order.

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables an iron-vane type voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

Ordering Information

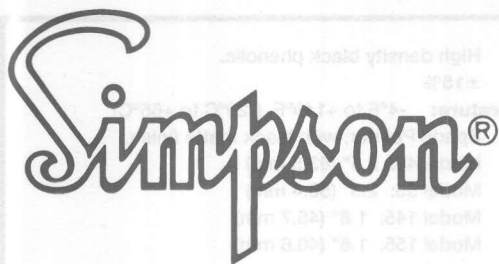
AC Volts 166 Ohms/Volt

Range	Approx. Impedance (Ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

Function Reference Table

For your convenience, the table below lists Round models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	19-20
DC Current	C	77-78
DC Voltage	C	107-108
Decibels	C	133-134
RF Current	C	163-164
Watts	C	184-185
DC Galvanometers	C	77-78

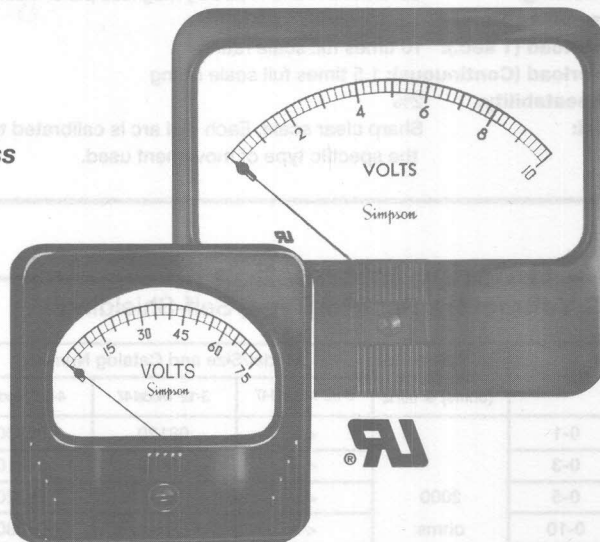


AC Voltage Meters

Rectangular Style

- **UL Recognized**
- **Phenolic Cases and Glass Windows**
- **Calibration Not Affected When Mounted on Steel Panels**
- **Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"**

For unsurpassed stability and quality performance, look to Simpson's rectangular style meters. The rectangular style offers a popular look with sharp, beveled edges and glass windows for easy viewing. AC units have either iron-vane or rectifier type movements. The magnetically damped iron-vane movement allows the meter to be mounted in steel panels with no affect to its calibration. All ranges are calibrated to 60 Hz. Iron-vane type voltage meters have frequency ranges of 25-125 Hz (for $\pm 1\%$ deviation from value at 60 Hz). Calibration to 800 Hz available on special order (All rectifier types have 25 Hz to 10 KHz range). Three different standard sizes of 2-1/2", 3-1/2", and 4-1/2" are available to measure varying AC voltage ranges. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

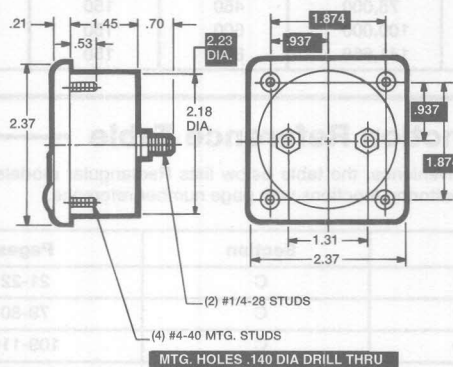


Model Number	Size	Meter Movement
157	2-1/2"	Iron-Vane
147	2-1/2"	Annular-Rectifier
57	3-1/2"	Iron-Vane
47	3-1/2"	Annular-Rectifier
59	4-1/2"	Iron-Vane
49	4-1/2"	Annular-Rectifier

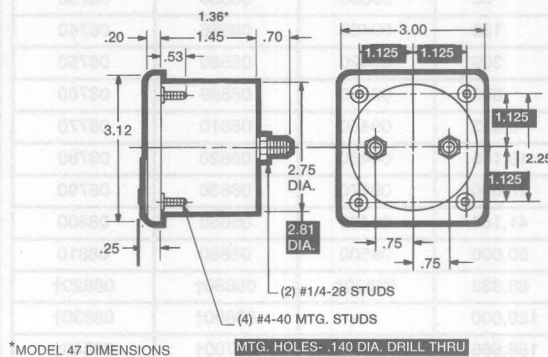
Dimensions and Compatibility

2-1/2"-Model 157 & 147

1 = Panel Meter Cut-out Dimensions

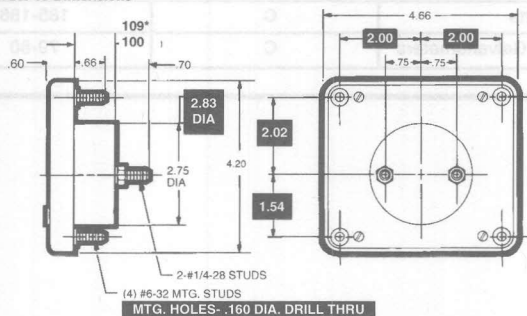


3-1/2"-Models 47 & 57



4-1/2"-Model 49 & 59

* Model 49 Dimensions



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Beede	—	15	16/458
Hoyt	—	598	648/684
Modutec PB Series	2PB*	3PB*	4PB
Triplett S Series	227-T	327-*T	420
Yokogawa Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1

*Modutec Meters use a three-stud mount.

Specifications

Accuracy:	±2% F.S. (Iron-Vane); ±3% F.S. (Rectifier)
Movement:	Models 55, 155: Iron-Vane, magnetically damped Models 45, 145: Rectifier type, self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 45: 2.5" (63.5 mm) Model 55: 2.3" (58.4 mm) Model 145: 1.8" (45.7 mm) Model 155: 1.6" (40.6 mm)
Net Weight:	Model 45: 8 ozs (0.20 kg) Models 55 & 155: 5 ozs (0.14 kg) Model 145: 7 ozs (0.20 kg)

Ordering Information

AC Voltmeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 147	3-1/2" Model 47	4-1/2" Model 49
0-1	2000 ohms per volt	< >	08120	08300
0-3		< >	08130	08310
0-5		< >	< >	08320
0-10		< >	< >	08330
0-15		< >	< >	08340
0-50		< >	< >	08350
0-100		< >	08180	08360
0-150		< >	08190	08370
0-300		< >	< >	08371

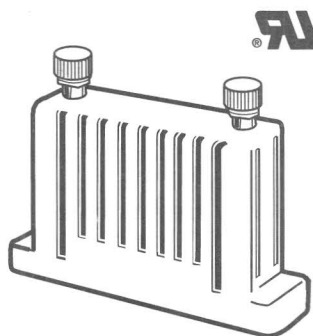
AC Voltmeters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		2-1/2" Model 157	3-1/2" Model 57	4-1/2" Model 59
0-1.5	3	< >	< >	08710
0-3	12	< >	08540	08720
0-5	33	09390	08550	08730
0-10	133	09400	08566	08740
0-15	300	09420	08580	08750
0-25	833	09440	08599	08760
0-50	3,333	09450	08610	08770
0-100	16,166	09460	08620	08780
0-150	25,000	09470	08630	08790
0-250	41,166	09490	08650	08800
0-300	50,000	09500	08660	08810
0-500	83,333	09520†	08680†	08820†
0-750	125,000	< >	08690†	08830†
0-1000	166,666	< >	08700†	08840†

† External multipliers, Model 183 are furnished on AC meters having a range of 500 volts or higher. All others have self-contained multipliers. < > Available on special order.

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables an iron-vane type voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltage meter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

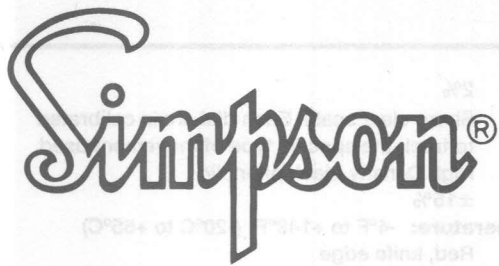
Ordering Information AC Volts 166 Ohms/Volt

Range	Approx. Impedance (Ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

Function Reference Table

For your convenience, the table below lists Rectangular models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	21-22
DC Current	C	79-80
DC Voltage	C	109-110
Decibels	C	135-136
RF Current	C	165-166
VU	C	173-174
Watts	C	185-186
DC Galvanometers	C	79-80



AC Voltage Meters

Designer Style



- **$\pm 2\%$ of Full Scale Accuracy**
- **Clean, Uncluttered Look**
- **Maximum Readability in Minimum Required Height**
- **Two Popular Sizes: 3-1/2", 4-1/2"**
- **Calibration Not Affected When Mounted on Steel Panels**
- **Phenolic Cases with Glass Windows**

Look to the Designer Series to be used in today's compact equipment designs — without sacrificing readability. The professional styling Designer meters offered by Simpson takes up less than 3 inches of panel height, yet the scale is over 3-1/2 inches long.

With a black phenolic case and glass window for optimum viewing, the Designer has a red knife-edge pointer, providing excellent readability and ± 2 percent full scale accuracy. The 3-1/2 inch and 4-1/2 inch sizes

feature an iron-vane magnetically damped meter movement which allows the meter to be mounted in steel panels with no affect to its calibration. All meters are calibrated at 60 Hz and have a frequency range of 25 through 125 Hz. Calibration to 800 Hz is available on special order. This style can also be chosen for other electrical monitoring functions to fit your specific application. Refer to the "Function Reference Table" herein for the page number to obtain more detailed information for a specific function.

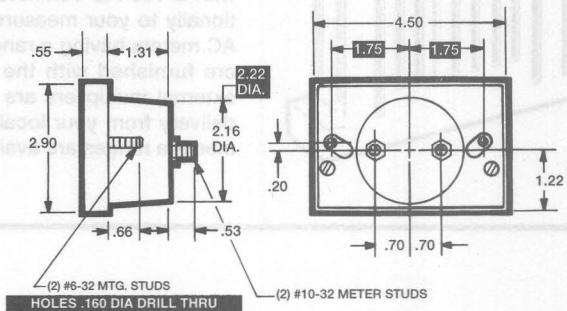
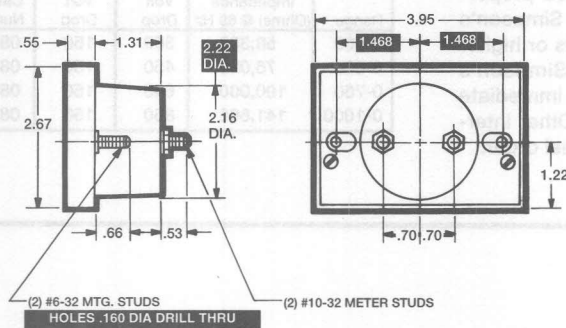
Model Number	Size	Meter Movement
553	3-1/2"	Iron-Vane
554	4-1/2"	Iron-Vane

Dimensions and Compatibility

3 1/2"-Model 553

1 = Panel Meter Cut-out Dimensions

4 1/2"-Model 554



Compatibility Reference Table

Manufacturer	Size/Model	
	3 1/2"	4-1/2"
Hoyt	2136	2146
Triplett R Series	330-R	430-R

Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Iron-Vane, magnetically damped
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating

Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High Density black phenolic
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Red, knife edge
Scale Length: Model 553: 2.69" (68.3 mm)
 Model 554: 2.84" (72.1 mm)
Net Weight: Model 553: 6 ozs (0.17 kg)

Ordering Information

AC Voltage Meters Iron-Vane Type Movement

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		3-1/2" Model 553	4-1/2" Model 554
0-150 *	25,000	15060	15130
0-250 *	41,166	15061	15131
0-300 *	50,000	15062	15132

* Rectifier Models 543 and 544 are available on special order.

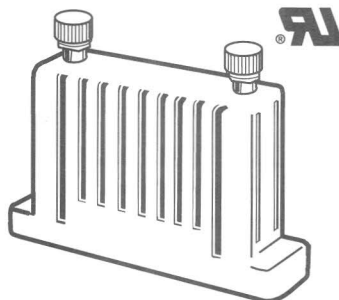
Function Reference Table

For your convenience, the table below lists Designer models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	23-24
DC Current	C	81-82
DC Voltage	C	111-112
VU	C	175-176

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables an iron-vane type voltage meter to monitor up to 1000 AC Volts. An external multiplier is used with a 150 AC voltmeter that is scaled proportionally to your measurement range. Simpson's AC meters having a range of 500 volts or higher are furnished with the Model 183. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available on special order.

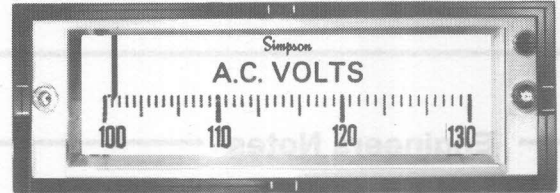
Ordering Information AC Volts 166 Ohms/Volt

Range	Approx. Impedance (Ohms) @ 60 Hz	Volt Drop	Meter Volt Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565



AC Voltage Meters

Edgewise Style-3-1/2"



- Quick, Front Panel Mounting
- Accuracy at $\pm 3\%$ of Full Scale
- Rugged Steel Case
- Horizontal Mounting, Vertical on Special Order
- Self-Shielding Core Magnet Movement
- Compact and Lightweight

Model Number	Size	Meter Movement
3643	3-1/2"	Rectifier

Simpson's Model 3643 Edgewise panel meter has been designed to satisfy the increasing demand for an attractive and accurate analog display in a minimum of panel space. The pivot and jewel suspension Edgewise meter provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility, unsurpassed stability and optimum performance.

A unique Simpson self-shielding 1-15/16" shallow core magnet movement provides $\pm 3\%$ full scale standard accuracy for either horizontal or vertical (special order) scale orientations.

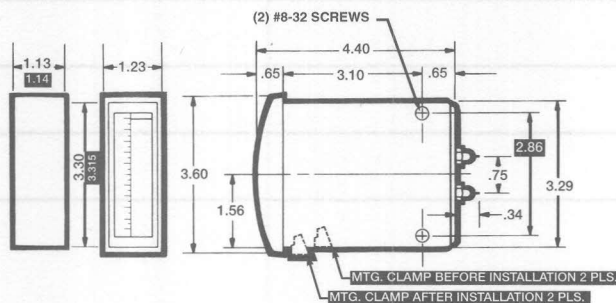
With the 3-1/2" Edgewise meter, panel mounting is simple and quick.

A front bezel Allen screw operates a lock, which slides across a wedge-shaped cam surface, locking the instrument in place. When removing, the lock recesses into a slot on the side of the instrument. No additional mounting hardware is required.

This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility

3-1/2"-Model 3643



1 = Panel Meter Cut-out Dimensions

Compatibility Reference Table

Manufacturer	Size/Model
	3-1/2"
Westcon 2000 Series	231

Specifications

Accuracy:	$\pm 3\%$ F.S. ($\pm 1\%$ special order)	Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Movement:	Shallow Core Magnet Rectifier	Case:	Steel top and bottom with valox polyester frame and acrylic window.
Suspension:	Taut Band or Pivot and Jewel	Resistance:	$\pm 15\%$
Tracking:	$\pm 3\%$	Operating Temperature:	-4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Shielding:	Calibration is unaffected by magnetic panel mounting.	Pointer:	Lance pointer — black
Response Time:	1.5 seconds maximum	Scale Length:	2.6" (66 mm)
Overload (1 sec.):	10 times full scale rating	Net Weight:	9 oz. (0.26 kg)
Overload (Continuous):	1.5 times full scale rating		
Repeatability:	2%		

C
5
4

Accuracy:	±3% F.S.
Movement:	Small Core Magnet-Rectifier
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case:	Molded Acrylic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Lance, with red matte finish
Scale Length:	Model 1541: 1.375" (35 mm) Model 1542: 1.875" (47.6 mm)
Net Weight:	Model 1541: 2 oz. (0.06 kg) Model 1542: 4 oz. (0.11 kg)

Ordering Information

AC Voltage Meters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number	
		1-1/2" Model 1541	2-1/2" Model 1542
0-150	1000 Ω/V	10415	10420
0-300	1000 Ω/V	< >	10430

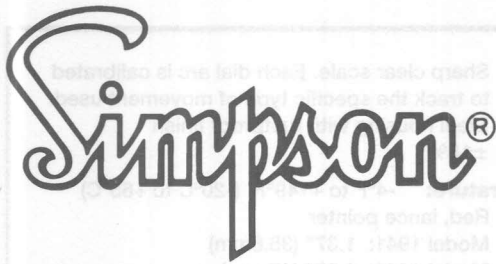
< > Available on special order

Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions with page number reference.

Function	Section	Pages
DC Current	C	85-86
DC Voltage	C	115-116
VU	C	177-178

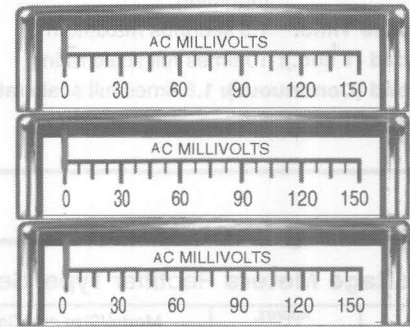
Engineers Notes



AC Voltage Meters

Edgewise Stackable

- Compact and Lightweight
- Dustproof Construction
- Steel Housing
- Rustproof Finish
- Two Sizes: 1-1/2", 2-1/2"



Model Number	Size	Meter Movement
1941	1-1/2"	Thin Core
1642	2-1/2"	Magnet-Rectifier

Simpson's miniature Edgewise panel meter has a unique thin core magnet movement that eliminates the protruding barrel which is prevalent in other edgewise meter designs. It lends itself to a meter that is modern and extremely compact. The 2-1/2" meter is supplied with mounting hardware and bezel. The rugged steel case has a rustproof finish and a dustproof construction for optimum performance in less than ideal environments. The rectifier type, self-shielding meter movement provides $\pm 3\%$ full scale accuracy. The scale extends nearly to the full width and height of the

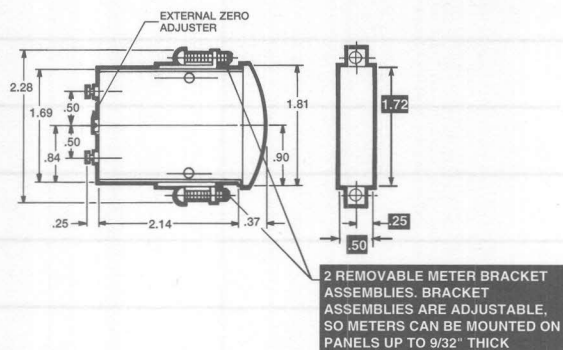
meter. An optimum scale display area permits the use of large easy-to-read numerals on a horizontal plane.

This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

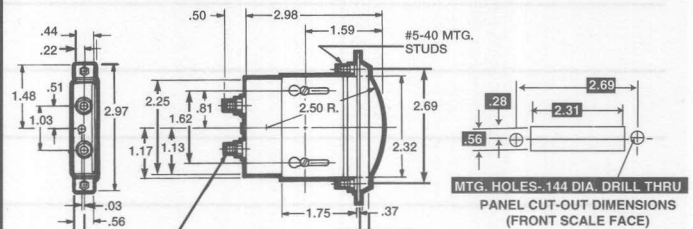
Dimensions and Compatibility

1-1/2"-Model 1941

1 = Panel Meter Cut-out Dimensions



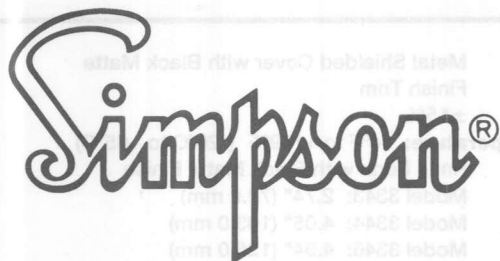
2-1/2"-Model 1642



Compatibility Reference Table

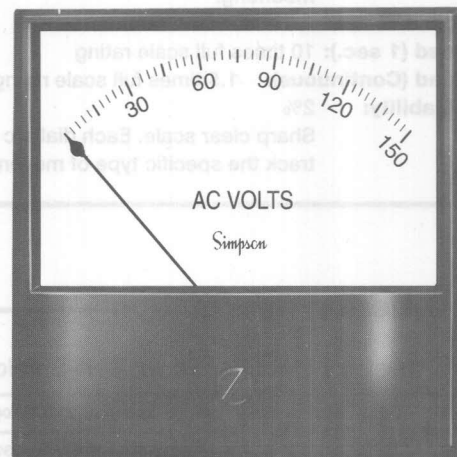
Manufacturer	Size/Model
	1-1/2"
Crompton	170 Series
Modutec	2E

Engineers Notes



AC Voltage Meters

Rugged Seal Style



Model Number	Size	Meter Movement
3343	3-1/2"	Rectifier
3344	4-1/2"	Rectifier
3346	4x6"	Rectifier

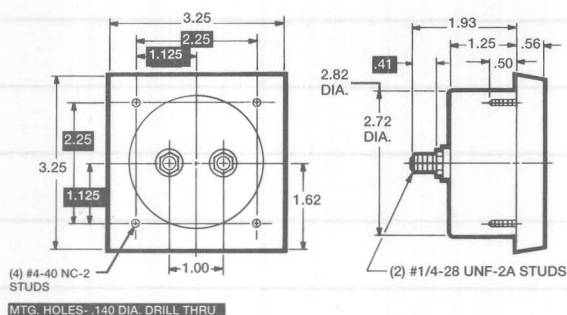
- **Rugged Metal Case for Rigorous Environments**
- **Moisture and Dust Proof Commercially Sealed**
- **Calibration Not Affected by Steel Panel Mounting**
- **Three Sizes: 3-1/2", 4-1/2", 4x6"**
- **O-Ring Sealed Zero Adjust and Electrical Termination**

Specifically designed for harsh environments, Simpson's Rugged Seal panel meters are ideal for use in field test equipment or wherever rigorous environmental conditions are encountered. This line of panel meters offers a stylish look with its black metal case and clear glass window. The metal case gives complete magnetic isolation which is especially important in steel panel mounting where stray magnetic fields can induce errors in your reading. In addition, each meter is moisture, dirt, and dust proof. For applications where wash down of control panels is necessary, the Rugged Seal meters are splash proof and offer excellent resistance to water. For added environmental protection, both zero adjust and electrical terminals are O-ring sealed. The Rugged Seal meters are available in three convenient sizes; 3-1/2", 4-1/2", and 4x6".

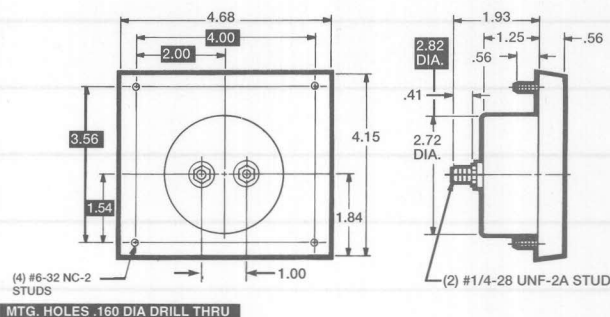
All AC units have rectifier type, self-shielding meter movements with pivot and jewel suspension and offer $\pm 3\%$ of full scale accuracy. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

Dimensions and Compatibility

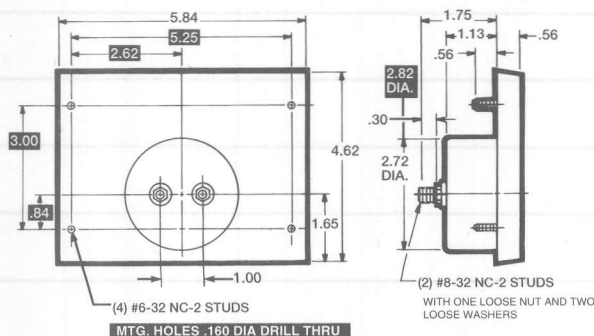
3-1/2"-Model 3343



4-1/2"-Model 3344



4x6"-Model 3346



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec K Series	K3S	K4S

Specifications

Accuracy:	±3% F.S.
Movement:	Annular Rectifier
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case:	Metal Shielded Cover with Black Matte Finish Trim
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Knife Edge with Black Matte Finish
Scale Length:	Model 3343: 2.74" (70.0 mm) Model 3344: 4.05" (103.0 mm) Model 3346: 4.94" (125.0 mm)
Net Weight:	Model 3343: 12 ozs (0.340 kg) Model 3344: 17 ozs (0.48 kg) Model 3346: 19 ozs (0.54 kg)

Ordering Information

AC Voltmeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/Size and Catalog Number		
		3-1/2" Model 3343	4-1/2" Model 3344	4x6" Model 3346
0-150	1000 ohms per volt	16065	16160	< >
0-300		16070	16165	16260

<> Available on special order.

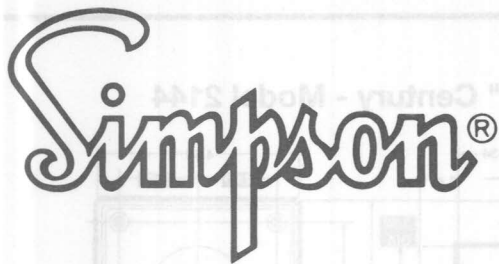
Function Reference Table

For your convenience, the table below lists Rugged Seal models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	27-28
DC Current	C	89-90
DC Voltage	C	119-120

Engineers Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.



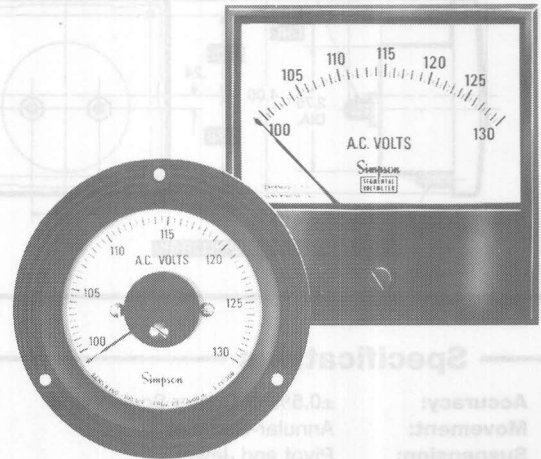
AC Voltage Meters

Segmental Scale

- 0.5% of Center Scale Value Accuracy
- Average Sensing
- .025% Resolution
- Phenolic or Steel Cases
- Expanded Full Scale Length
- Two popular sizes: 3-1/2", 4-1/2"

Simpson's Segmental Scale meters are highly accurate panel instruments with easy-to-read linear scales. They are used wherever fast, precision monitoring of complex circuits is essential. Segmental Scale AC Voltmeters present a selected voltage range across the entire dial face in linear fashion. Where the significant voltage range of a conventional meter is squeezed into a quarter of an inch of space, Simpson Segmental meters distribute that range across the entire dial, making possible readings with a resolution of .025% and an accuracy of $\pm 0.5\%$ of center scale value. Thus, only the important segment of the voltage range appears.

AC Segmental Voltmeters are average sensing units. Offered in four popular case styles of Round,



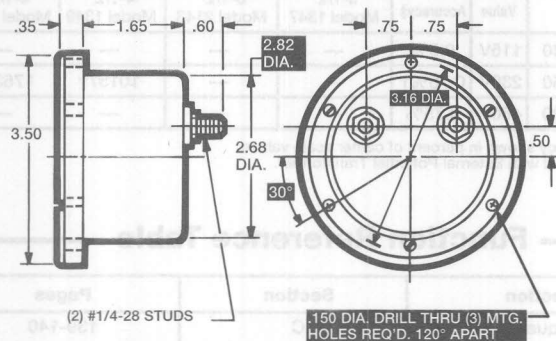
Model Number	Size	Meter Movement
2543	3-1/2"	Rectifier
2143L	3-1/2"	Rectifier
2143 & 1347	3-1/2"	Rectifier
1349 & 2144	4-1/2"	Rectifier

Rectangular, Wide-Vue and Century, the Segmental scale meters are a definite aid to the efficiency, reliability and long life of costly equipment. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

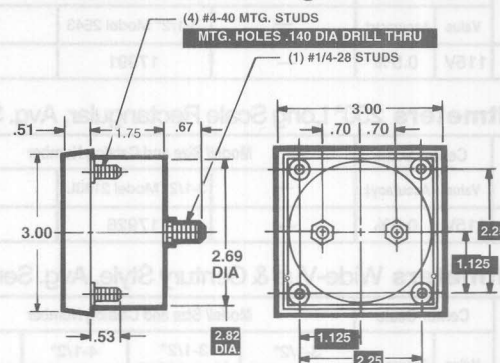
Dimensions

1 = Panel Meter Cut-out Dimensions

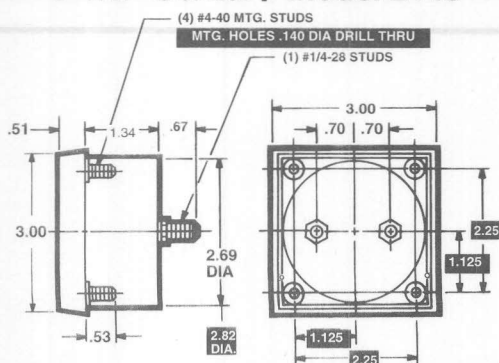
3-1/2" 250° Round-Model 2543



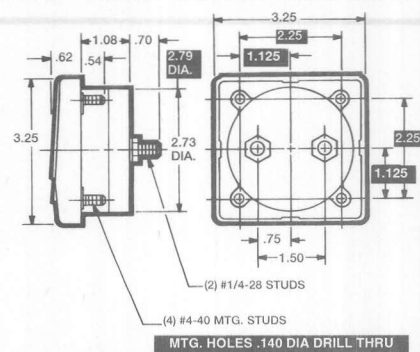
3-1/2" 250° Rectangular-Model 2143L



3-1/2" Century-Model 2143



3-1/2" Wide-Vue-Model 1347



Accuracy: $\pm 0.5\%$ of Center Scale Value
Movement: Annular-Rectifier
Suspension: Pivot and Jewel
Tracking: $\pm 1\%$
Shielding: Calibration is unaffected by magnetic panel mounting.

Response Time: 1.5 seconds maximum

Overload (1 sec.): 10 times full scale rating

Overload (Continuous): 10 times full scale rating

Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance: $\pm 15\%$

Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)

Case: Models 2543 Metal, All other models: Black Phenolic

Pointer: Model 2144: Black spade

All other models: Black knife edge.

Scale Length: Models 2543 & 2143L: 4.77" (121.15 mm)

Model 2143: 2.75" (69.8 mm)

Model 1347: 3.14" (79.9 mm)

Model 1349: 3.93" (100 mm)

Model 2144: 3.71" (94.2 mm)

Net Weight: Models 2543, 2143L, 2143 & 1347: 8 oz (0.23 kg)

Model 1349: 9 oz. (0.26 kg)

Ordering Information

AC Voltmeters 250° Long Scale Round, Avg. Sensing

Range	Center Scale		Model/ Size and Catalog Number		
	Value	Accuracy‡	—	3-1/2" Model 2543	—
100-130	115V	0.5%	—	17991	—

AC Voltmeters 250° Long Scale Rectangular, Avg. Sensing

Range	Center Scale		Model/ Size and Catalog Number		
	Value	Accuracy‡	—	3-1/2" Model 2143L	—
100-130	115V	0.5%	—	17926	—

AC Voltmeters Wide-View & Century Style, Avg. Sensing

Range	Center Scale		Model/ Size and Catalog Number			
	Value	Accuracy‡	3-1/2" Model 1347	3-1/2" Model 2143	4-1/2" Model 1349	4-1/2" Model 2144
100-130	115V	0.5%	10152	17548	10155	17638

Triple Range AC Voltmeters Wide-View & Century Style,

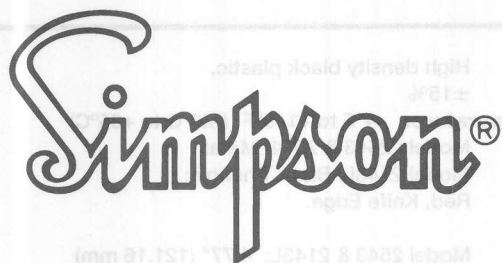
Range	Center Scale		Model/ Size and Catalog Number			
	Value	Accuracy‡	3-1/2" Model 1347	3-1/2" Model 2143	4-1/2" Model 1349	4-1/2" Model 2144
100-130	115V	0.5%	—	—	—	—
200-260	230V	0.75%†	—	—	10157†	17639†
400-520	460V	0.75%	—	—	—	—

‡ Accuracy shown in percent of center scale values.

† Supplied with External Potential Transformer.

Function Reference Table

Function	Section	Pages
Frequency	C	139-140

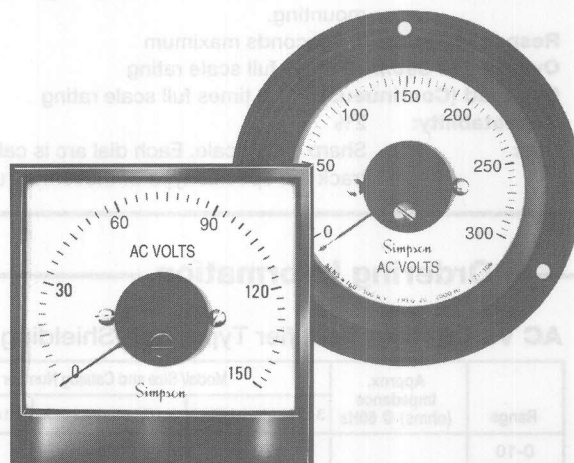


AC Voltage Meters

250° Long Scale Style

- More Than Double the Scale Length
- Phenolic and Shielded Metal Cases
- Round or Rectangular Case
- Zero Adjust From Front Panel
- Two Sizes: 3-1/2", 4-1/2"
- External Zero Adjust

Look to the 250° Long Scale analog meters for a full 250° readability that provides more than double the scale length of the standard 90° or 100° movements. Simpson's 250° panel meters are designed for applications that require high-resolution readings all in a compact and attractive design. They are rectifier type, self-shielded, moving coil instruments with nonmagnetic pivots and spring-backed jewels. The movement construction allows the meter to be mounted on steel panels. These easy-to-read meters are available in either sealed round metal or in molded rectangular phenolic cases with glass windows. The zero adjust is conveniently located on the external front portion of

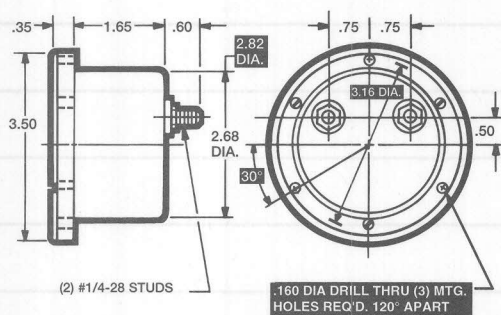


Model Number	Size	Meter Movement
2543	3-1/2"	Rectifier
2143L	3-1/2"	Rectifier
2544	4-1/2"	Rectifier

the meter. Two different standard sizes of 3-1/2" and 4-1/2" are available in selected voltage ranges. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

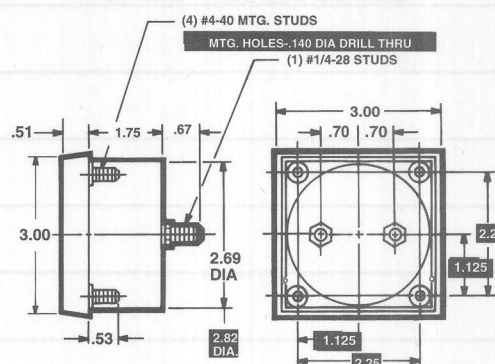
Dimensions and Compatibility

3-1/2"-Model 2543

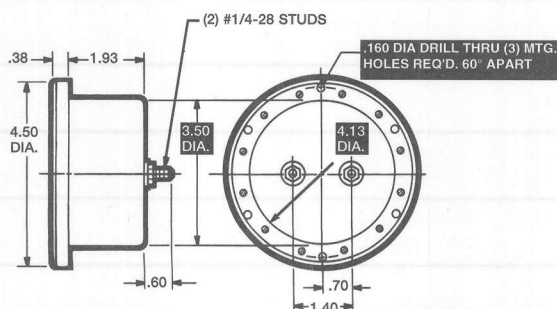


1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 2143L



4-1/2"-Model 2544



Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Rectifier type, self-shielding
Suspension: Pivot and Jewel
Tracking: 3%
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: High density black plastic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Models 2543 & 2544: Metal
 Model 2143L: Black Phenolic
Pointer: Red, Knife Edge.
Scale Length: Model 2543 & 2143L: 4.77" (121.16 mm)
 Model 2544: 6.54" (166.0 mm)
Net Weight: Models 2543 & 2143L: 8 oz (230 g)
 Model 2544: 9 oz (260 g)

Ordering Information

AC Voltmeters Rectifier Type, Self-Shielding

Range	Approx. Impedance (ohms) @ 60Hz	Model/ Size and Catalog Number		
		3-1/2" Model 2543	3-1/2" Model 2143L	4-1/2" Model 2544
0-10	2000 Ω/V	17990	< >	17995
0-30		< >	17915	< >
0-150		17978	17916	17988
0-300		17979	19717	17989

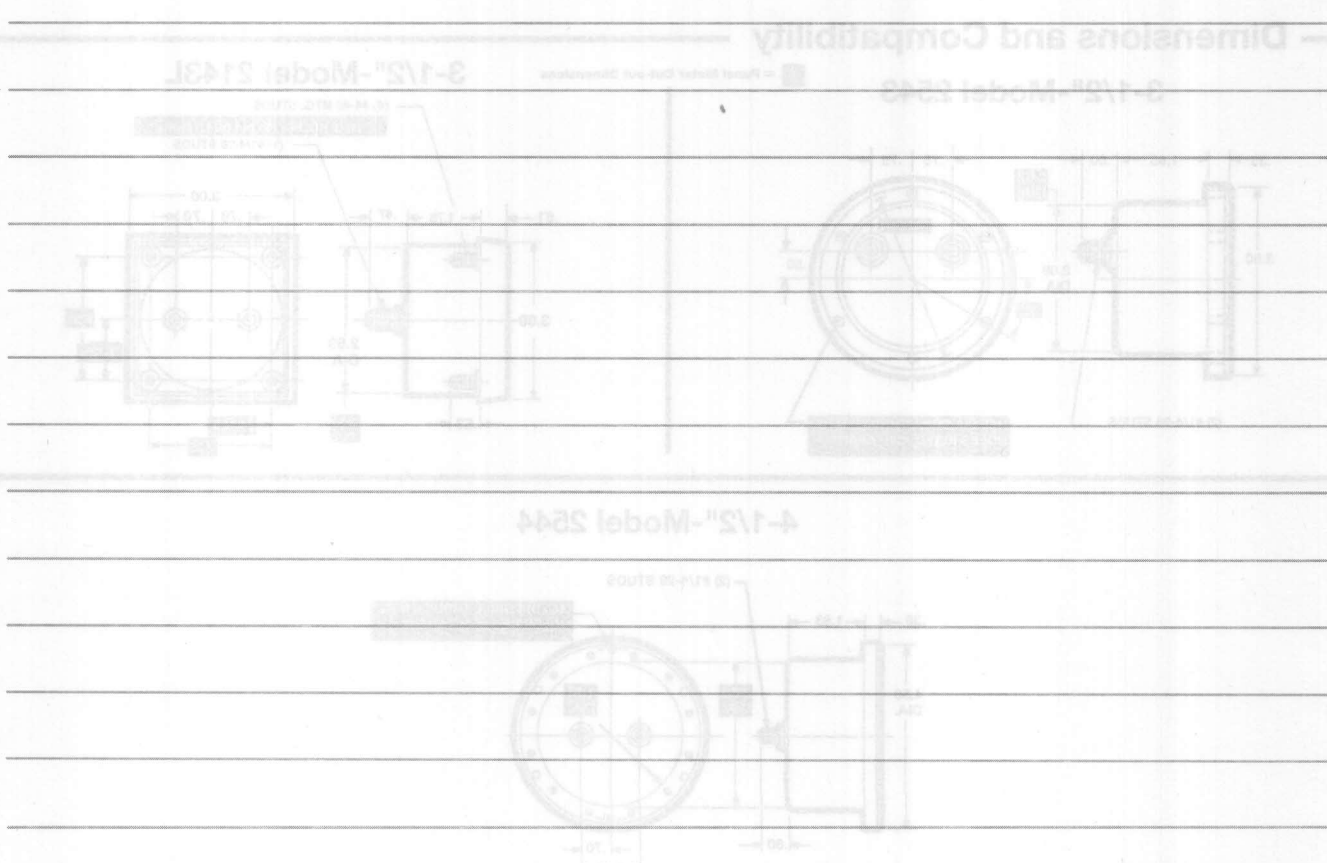
<> Available on special order.

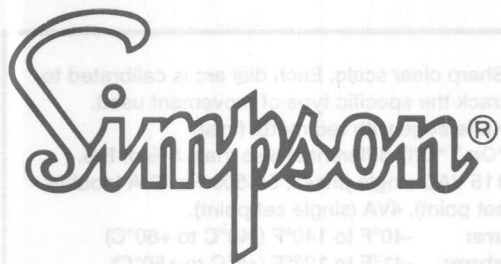
Function Reference Table

For your convenience, the table below lists 250° Long Scale models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	29-30
DC Current	C	91-92
DC Voltage	C	121-122

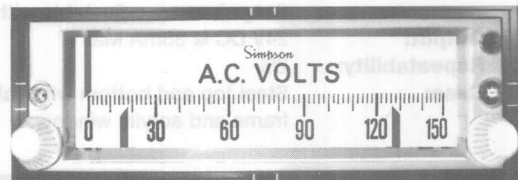
Engineers Notes





AC Voltage Meters

Edgewise Controller



- $\pm 3\%$ Standard Accuracy
- Pivot and Jewel Suspension
- Double or Single Setpoints
- Mode Indication Lamps
- Stacked or Individually Mounted
- Horizontal Mounting (Vertical Mounting On Special Order)
- Control Switching Within 1.0% of Setpoints
- Integral Mounting Lock for Easy Installation
- Removable Set Knobs

Model Number	Size	Meter Movement
3643XO	3-1/2"	Shallow Core Type

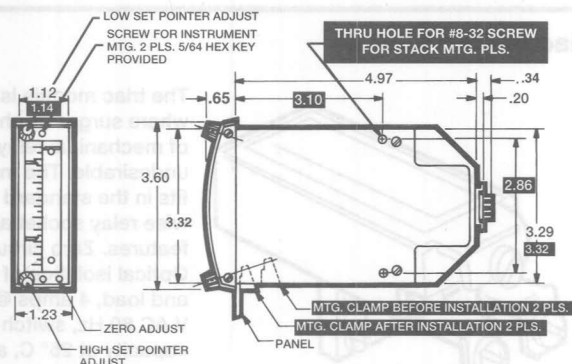
Simpson's Model 3643XO Edgewise Controllers offer an attractive and accurate analog display in a minimum of panel space. The controller provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility and unsurpassed stability. Mounting clips are attached to the controller housing and then tightened against panel without using screws for simplified panel mounting. A unique Simpson self-shielding core magnet provides ± 3 percent F.S. standard accuracy for either horizontal or vertical scale orientations. Each

unit can be stacked or mounted individually. This controller features single or double setpoints with mode indications lamps. DPDT relays or triacs (sold separately) are available for each setpoint. The single setpoint provides 0-100% adjustability while the dual setpoint units offer 0-98% for low and 2-100% high. All models can be set within 2° of each other for accurate measuring capability. Each knob is removable to prevent tampering. Control switching is within 1.0% of setpoints and dead band is less than 0.5% of full scale.

Dimensions and Compatibility

3-1/2"-Model 3643XO

1 = Panel Meter Cut-out Dimensions

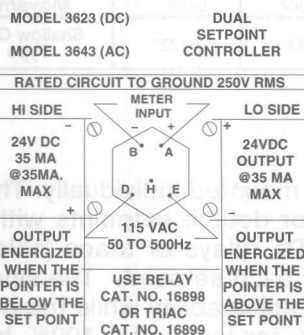


Specifications

Accuracy: $\pm 3\%$ F.S.
Switching Accuracy: Within 1% F.S. of setpoint indication
Movement: Self-shielding core type
Suspension: Pivot and Jewel
Maximum Sensitivity: 1000 ohms/volt
Single Setpoint: High limit standard, adjustable 0-100% F.S.
Double Setpoint: Low 0-98% of F.S.; high limit 2-100% of F.S.
 Set points are adjustable within 28
Output: 24V DC @ 35mA Max
Repeatability: 2%
Case: Steel top and bottom with valox polyester frame and acrylic window.

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Pointer: Knife edge with red matte finish
Dead Band: "On," "Off" differential less than .5% of F.S.
Input Power: 115 VAC single phase, 50-500 Hz. 6VA (double set point), 4VA (single set point).
Storage Temperature: -40°F to 140°F (-40°C to +60°C)
Operating Temperature: -41°F to 122°F (+5°C to +50°C)
Scale Length: 2.6" (66mm)
Weight: 10 ozs. (0.28g)
Tracking: $\pm 3\%$

Connections



Input Signal: Input to be monitored is connected to pins A(+) and B(-).

Supply Power: The power source (115 VAC, 50 to 500Hz) for meter operation is connected to pins D and E.

Output: The model 3643 supplies a 24VDC@35mA switching current for each relay (cat. #16898) or triac switch module (cat. #16899). Connect the output to the (+) and (-) terminals on the back of the controller as outlined on the diagram.

Ordering Information

AC Voltmeters — Edgewise Controller

Range	Catalog Number
0-10 V AC SSP*	19325
0-10 V AC DSP*	19326
0-150 V AC SSP	19327
0-150 V AC DSP	19328

SSP-Single Setpoint
 DSP-Double Setpoint

*For use with Model 186 current transformer

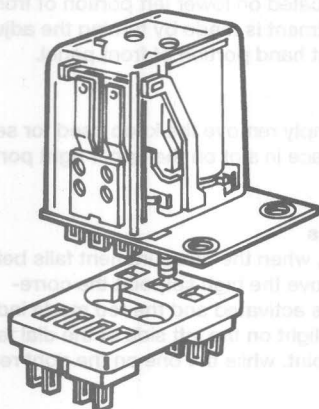
Function Reference Table

For your convenience, the table below lists Edgewise controller models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	31-32
DC Current	C	93-94
DC Voltage	C	123-124

Accessories

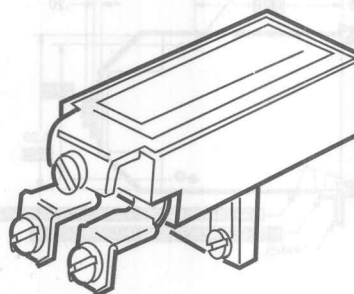
Relay Assembly Kit



This Relay Assembly Kit gives the Edgewise Controller the capability to switch a 5 amp load for a setpoint setting. The kit contains one DPDT Relay and Socket Type connector, rated at 5 Amperes resistive load at 120 VAC for each relay pole. The relay can be wired for automatic or manual reset operation. Relay is factory wired for automatic reset operation. The mechanical life of the relay is 1,000,000 operations at rated load.

See Accessories Section for Model 186 Transformer

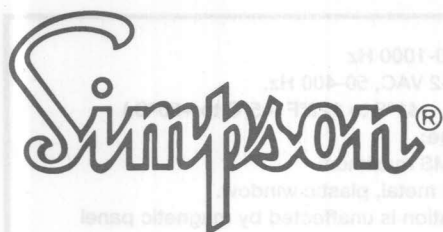
Triac Switch Module



The triac module is used where surges or chatter of mechanical relays are undesirable. The module fits in the standard edgewise relay socket and features. Zero circuitry, Optical isolation of signal and load, 4 amps @ 120 V AC 60 Hz, switch capacity at 25° C, and normally open single pole-single throw.

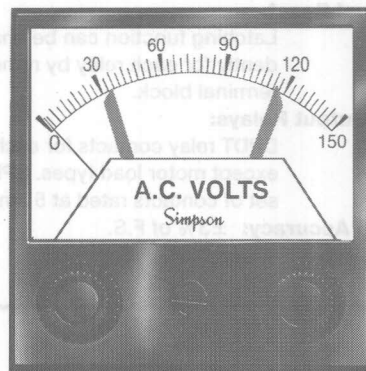
Ordering Information

Description	Catalog Number
Relay Assembly kit	16898
Triac Switch Module	16899



AC Voltage Meters

Rugged Seal Controller



Model Number	Size	Meter Movement
3343AIXA	3-1/2"	Annular-Rectifier
3344AIXA	4-1/2"	Annular-Rectifier
3346AIXA	4x6"	Annular-Rectifier

- **Commercially Sealed**
- **Moisture & Dust Proof**
- **Wide Variety of Control**
- **Rugged Case for Rigorous Environments**
- **Three Sizes: 3-1/2", 4-1/2", 4x6"**
- **Alarm and Limit Use**

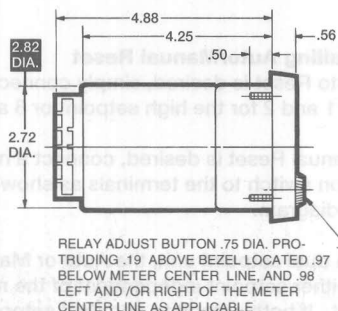
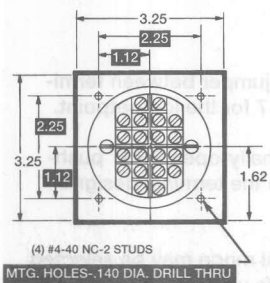
The 33 Series instruments offer a wide variety of applications in control, alarm and limit use. Photo conductor sensing eliminates all interference with the indicating meter. These controllers incorporate an amplifier input which drives a rugged high torque pivot and jewel or taut-band meter. Metal cased "Rugged Seal" construction withstands rigorous environmental conditions. The diecast metal bezel with a drawn steel rear case (plated) gives complete magnetic isolation for steel panel mounting. In addition, each meter is moisture, dust, and dirt proof and recommended for use in wash down areas. Fail safe circuitry opens output relays in the event of power failure. Three different sizes of 3-1/2", 4-1/2", and 4x6" are available in both single and dual setpoint models. High-gain transistor switch circuit provides accurate switching with a "dead band" of no more than 0.5% of

full scale. All AC voltage units offer $\pm 3\%$ of full scale accuracy. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

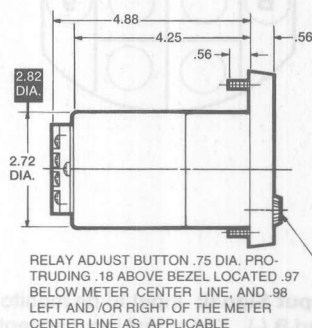
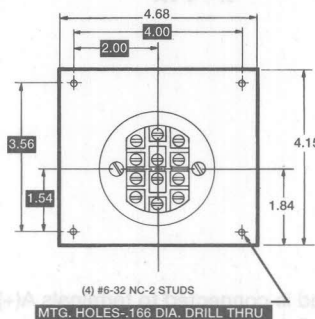
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

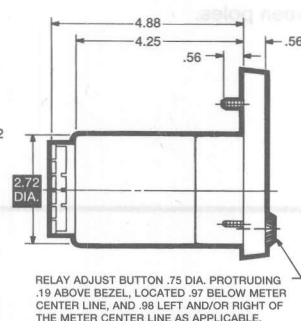
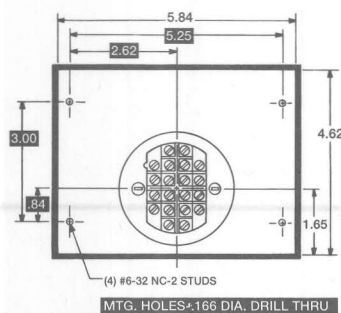
3-1/2"-Model 3343AIXA



4-1/2"-Model 3344AIXA



4x6"-Model 3326AIXA



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec		
YS Series	YS3	YS4
YD Series	YD3	YD4

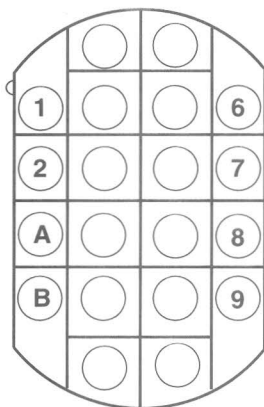
Specifications

Movement:	Self-shielding, annular
Adjustments:	Single, 0-100% of arc; double, low limit 0-95% of arc; high limit, 5-100% of arc. Adjustable to within 4° of each other.
Switching:	Within 1% of indication
Differential:	"On", "Off" difference is within 0.5% of F.S.
Auto/Manual Reset:	Latching function can be enabled independently for each relay by removing jumpers on terminal block.
Contacts/Output Relays:	DPDT relay contacts for each control point except motor load types. SPDT low point. Each set of contacts rated at 5 amps, 115 VAC.
Calibration Accuracy:	±3% of F.S.
Repeatability:	Within 0.5% F.S.

Frequency Response:	50-1000 Hz
Power:	108-132 VAC, 50-400 Hz.
Operating Temperature:	41°F to 122°F (+5°C to +50°C.)
Circuit-to-Ground Voltage:	250 RMS maximum
Case:	Sealed metal, plastic window.
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%

Wiring Diagram

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
- B. - SIGNAL INPUT
- 1. AUTO/MAN. RESET HI SETPOINT
- 2. SHORT FOR AUTO
- 6. AUTO/MAN. RESET LO SETPOINT
- 7. SHORT FOR AUTO
- 8. 120 VAC ±10%
50-400 Hz
- 9. 4 VA

Auto/Manual Reset

There are two modes of relay logic available in the 3344AIXA: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is de-energized when the pointer exceeds the high setpoint, and is automatically energized when the pointer again drops below the setpoint. The low setpoint relay is de-energized when the pointer drops below the low setpoint, and is automatically energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other set point. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent pushbuttons are usually used. However, one master reset button may be used for both setpoints provided it is a double pole switch with no electrical connection between poles.

Input Signal: Input to be monitored is connected to terminals A(+) and B (-). The signal input accepts 5 amperes AC full scale.

Input Power: The power source used is 120VAC ±10%, 50 to 400 Hz. The power requirement is nominally 5VA. Connect power source to terminals 8 and 9.

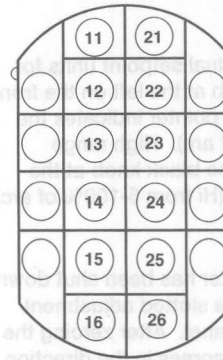
Relays

Relays can be used to "turn on" or "turn off" power to a process that the 3343AIXA and 3344AIXA are monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to change in condition in the process. The controller's relays for both single and dual setpoint meters are double pole, double throw relays.

High Setpoint: The high setpoint relay contacts (on both single and dual setpoint meters) are de-energized when the pointer is above the desired set point. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (appear on dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminals 21 and 24. Terminals 22 and 25 are moving contacts or common. Use terminals 23 and 26 for normally closed relays.

REAR VIEW OF HEADER

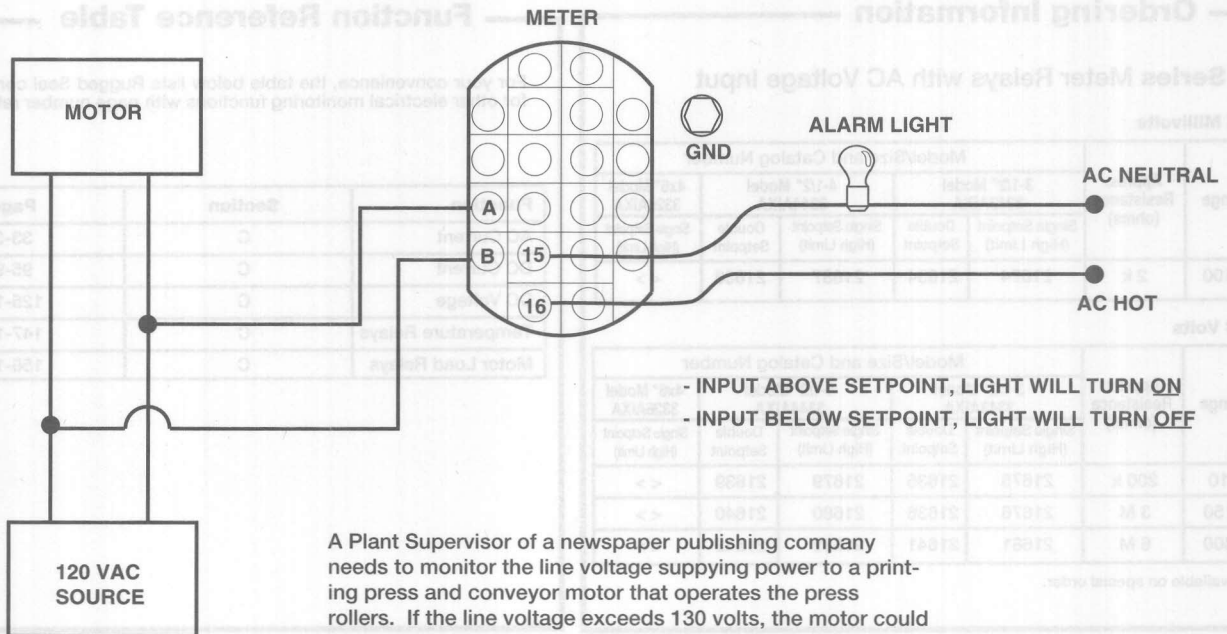


TERMINAL DESIGNATIONS

11. NO	HIGH SETPOINT.
12. C	RELAY IS
13. NC	DE - ENERGIZED
14. NO	WITH POWER POINTER
15. C	ABOVE SETPOINT.
16. NC	
21. NO	LOW SETPOINT.
22. C	RELAY IS
23. NC	DE - ENERGIZED
24. NO	WITH POWER POINTER
25. C	BELOW SETPOINT.
26. NC	

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Application Example



- INPUT ABOVE SETPOINT, LIGHT WILL TURN ON
- INPUT BELOW SETPOINT, LIGHT WILL TURN OFF

A Plant Supervisor of a newspaper publishing company needs to monitor the line voltage supplying power to a printing press and conveyor motor that operates the press rollers. If the line voltage exceeds 130 volts, the motor could burn up, thus shutting down the printing operation. In the event that a power surge happens, the maintenance team needs to be notified so as to activate a back-up generator to finish the newspapers and continue the printing process.

A Model 3343AIXA single setpoint controller (150 AC Volt) is installed in parallel between the source (line voltage) and the load (the conveyor motor) to monitor the line voltage. The Plant Supervisor adjusts the setpoint relay at 130 Volts. If the voltage goes above the setpoint the relay will de-energize and will "turn on" a light that will alert the maintenance team to this change in condition.

The signal input is connected to Terminal A(+) and Terminal B(-) on back of the controller. The relay contacts for a normally closed state are Terminals 15 (common) and 16 (normally closed).

Ordering Information**33 Series Meter Relays with AC Voltage Input****AC Millivolts**

Range	Approx. Resistance (ohms)	Model/Size and Catalog Number				
		3-1/2" Model 3343AIXA		4-1/2" Model 3344AIXA		4x6" Model 3326AIXA
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)
0-100	2 k	21674	21634	21687	21638	< >

AC Volts

Range	Approx. Resistance (ohms)	Model/Size and Catalog Number				
		3-1/2" Model 3343AIXA		4-1/2" Model 3344AIXA		4x6" Model 3326AIXA
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)
0-10	200 k	21675	21635	21679	21639	< >
0-150	3 M	21676	21636	21680	21640	< >
0-300	6 M	21681	21641	21682	21642	< >

<> Available on special order.

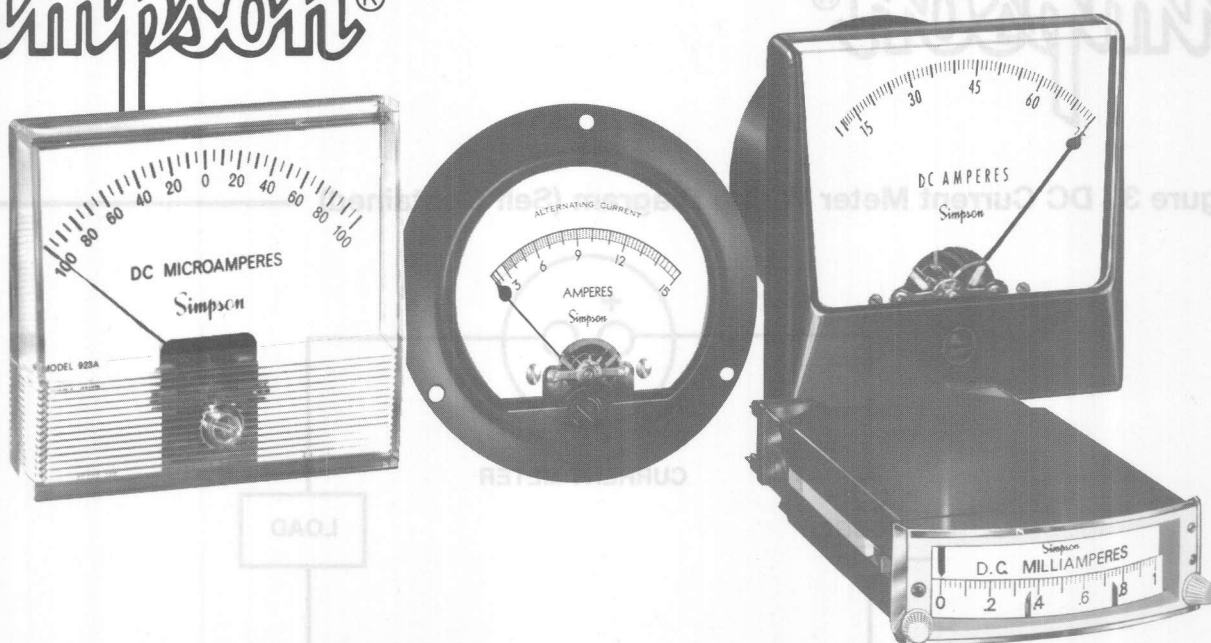
Function Reference Table

For your convenience, the table below lists Rugged Seal controller models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	33-36
DC Current	C	95-98
DC Voltage	C	125-128
Temperature Relays	C	147-150
Motor Load Relays	C	156-157



DC Current Meters



Simpson DC current meters are available in many standard models and ranges as well as in custom applications. Choose from 1-1/2", 2-1/2", 3-1/2", 4-1/2" and 4x6" sizes. Case styles include Round and Rectangular, Wide-Vue, Rugged Seal, 250° Long Scale, Designer, Century, 3-1/2" Edgewise, Edgewise Barrel, Edgewise Stackable and Tru-Vue.

While the Simpson Family of DC current meters all measure direct current, from millionths of amperes to hundreds of amperes, they are not exactly alike and differ in their applications. The Wide-Vue features modern styling with a durable, open-faced plastic cover for wide-angle readability and protection of the meter face. Round and Rectangular, Designer and Century series offer easy reading, attractive design and choice of case styles. The 250° Long Scale meter is designed for applications that require high resolution readings. 250° panel meters provide more than double the scale length of the standard models. Tru-Vue models feature a modern, clear acrylic front and clean, open scale to update your panel design. When every square inch counts or weight is a consideration, the 3-1/2" Edgewise and Edgewise Barrel meters fill these requirements. A self-shielding core magnet movement, unique to the Edgewise Stackable meter, eliminates the protruding barrel prevalent on other Edgewise Meters.

Current Shunts

A shunt is a precision low-value resistor placed across the terminals of an ammeter to increase its range. It may be either internal or external to the instrument. Generally, 1-1/2" DC current meters are self-contained through 10 amperes. Fifteen ampere and higher models are supplied as 50 mV meters to be used with external shunts. 2-1/2", 3-1/2", and 4-1/2" DC current meters are self-contained through 50 amperes. Higher range DC current meters are 50 mV meters to be used with external shunts.

Figure 1. Portable 150 Amp Shunts

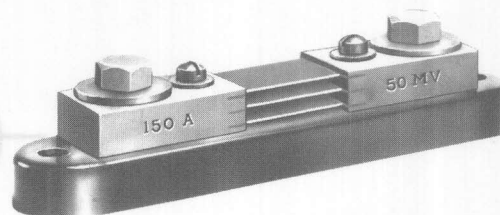
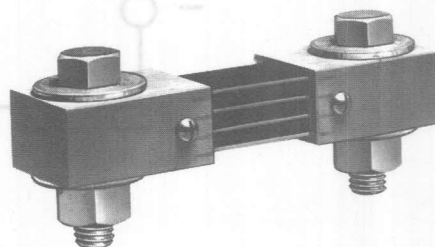
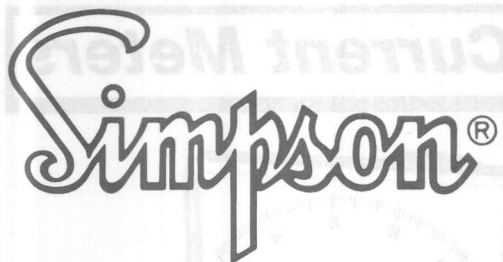


Figure 2. Switchboard 100 Amp Shunts





DC Current Meters

Figure 3. DC Current Meter Wiring Diagram (Self Contained)

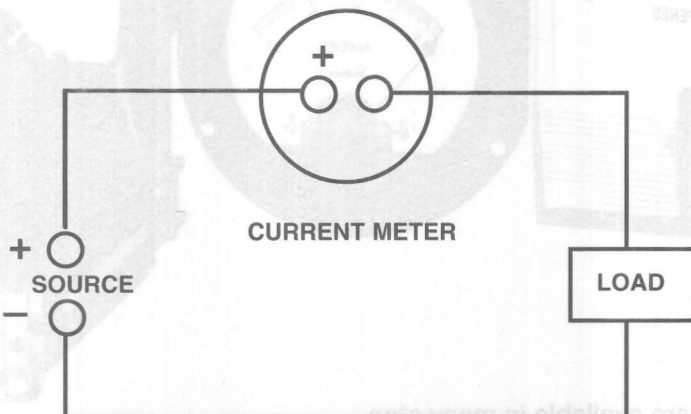
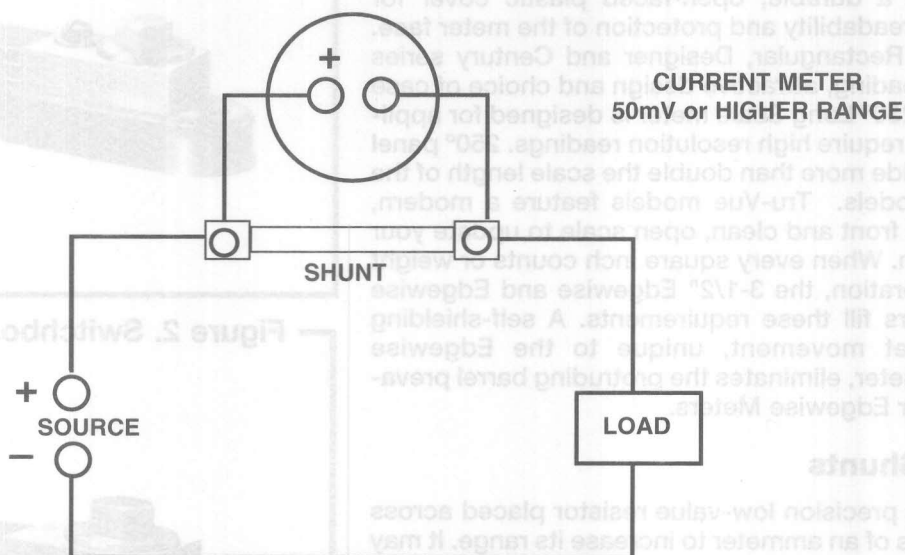
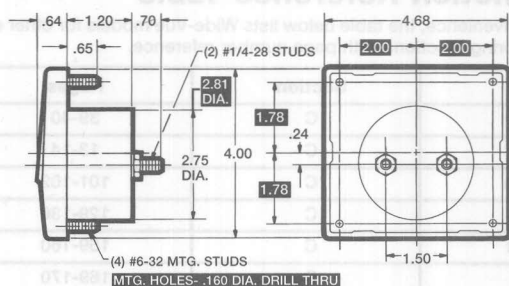


Figure 4. DC Current Meter Wiring Diagram (With External Shunt)





Specifications

Accuracy:	±2% F.S.
Movement:	Annular, Self-shielding (Models 1212, 1212T: Small Core Magnet)
Suspension:	Models 1212, 1227, 1327, 1329: Pivot and Jewel Models 1212T, 1227T, 1327T, 1329T: Taut-Band
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	Models: 1212T, 1227T, 1327T, 1329T: 0.5% (Taut-Band) Models: 1212, 1227, 1327, & 1329: 0.5%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black plastic.
Pointer:	Models 1212 & 1212T: Black lance; All other models: Spade pointer with black matte finish.
Scale Length:	Models 1212, 1212T: 1.50" (38.1mm); Models 1227, 1227T: 2.3" (58.4mm); Models 1327, 1327T: 3.14 (79.9mm); Models 1329, 1329T: 3.93" (100mm)
Net Weight:	Models 1212, 1212T: 2 oz. (0.06kg) Models 1227, 1227T: 6 oz. (0.17kg), Models 1327, 1327T: 8 oz (0.23 kg); Models 1329, 1329T: 9 oz (0.26 kg)

Ordering Information

DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212	2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
0-50	1800 (5500)*	04294	04310	04380	04480
0-100	1800	04295	04320	04390	04490
0-200	1100	04296	04330	04400	04500
0-500	90 (190)*	04297	04340	04410	04510
250-0-25	1800 (5500)*	04298	<>	04420	04520
50-0-50	1800	04302	04350	04430	04530
100-0-100	1100	04300	04351	04440	04540
500-0-500	43	04301	04352	04450	04550

<> Available on special order. * Impedance of Model 1212 shown in ()

Taut-Band DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212T	2-1/2" Model 1227T	3-1/2" Model 1327T	4-1/2" Model 1329T
0-5	5750	-	-	04358	04458
0-10	4900	-	04303	04359	04459
0-15	1960 (5500)*	04601	04304	04361	04461
0-25	1960	04602	04306	04371	04471
0-50	960	04603	04311	04381	04481
0-100	500	04604	04321	04391	04491
0-200	234	04605	04331	04401	04501

DC Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212	2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
0-1	43.0	06163	06175	06310	06470
0-3	2.0	<>	06180	06320	06480
0-5	2.0 (20)†	06164	06190	06330	06490
0-10	10.0 (2.2)†	06165	06200	06340	06495
0-15	6.6 (2.2)†	06166	06210	06350	06502
0-20	5.0	<>	06215	06360	06524
0-25	4.0 (6.0)†	06167	06220	06370	06530
0-50	2.0 (3.0)†	06168	06230	06380	06540
0-100	1.0 (1.5)†	06169	06240	06390	06550
0-150	.66 (1.0)†	06170	06250	06400	06560
0-200	.50 (.75)†	06171	06260	06410	06570
0-250	.40 (.60)†	06172	06270	06420	06580
0-300	.33 (.50)†	06173	06280	06430	06590
0-500	.20 (.30)†	06174	06290	06440	06600
0-750	.13	<>	<>	06450	06610
0-1000	.05	<>	06292	06460	06620

† Impedance of Model 1212 shown in () <> Available on special order

Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Voltage	C	39-40
AC Current	C	13-14
DC Voltage	C	101-102
Decibels	C	129-130
RF Current	C	159-160
VU	C	169-170
Watts	C	180-181

DC Current Meters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212	2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
0-1	.050	02431	02440	02640	02820
0-1.5	.033	<>	02450	02650	02830
0-2	.025	02432	02460	02660	02840
0-3	.0166	02433	02670	02670	02850
0-5	.010	02434	02480	02680	02860
0-10	.005	02435	02490	02690	02870
0-15	.0033*	02436†	02500	02700	02880
0-25	.0020*	02437†	02510	02710	02890
0-30	.0017	<>	02520	02720	02900
0-50	.001	02438†	02530	02730	02910
0-100	10.0	<>	02540†	02740†	02920†
0-150	10.0	<>	02550†	02750†	02930†
0-200	10.0	<>	02552†	02760†	02940†
0-300	10.0	<>	02554†	02770†	02950†
0-500	10.0	<>	<>	02780†	02960†
15-0-15	.0033	<>	<>	02790	<>
30-0-30	.0017	<>	<>	02800	<>
50-0-50	.001	<>	<>	02810	<>

† 1-1/2" DC current meters are self-contained through 10 amps. 15 amps and higher are supplied as 50 mV meters to be used with external shunts. 2-1/2", 3-1/2" and 4-1/2" DC current meters are self-contained through 50 amps. Higher range DC current meters are 50 mV meters to be used with external shunts.

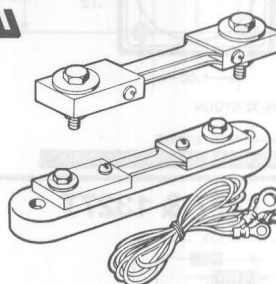
<> Available on special order. *Model 1212 only - 10 ohms

DC Galvanometers Self-Shielding Meter Movement

Range	Sensitivity μ A	Approx. Impedance (ohms)	Model/Size and Catalog Number		
			2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
50-0-50	500-0-500	43	03700	03730	03732
50-0-50	75-0-75	1800	03710	03720	03734

Accessories

External Portable and Switchboard Shunts



Portable

Switchboard

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Please refer to the Accessory Section of this Engineering Application Guide for detailed information.

Portable Shunts 50 mV

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts 100 mV

Amps	Cat.Number
10	06716
100	06717

NOTE: 5' leads not included

Switchboard Shunts 50 mV

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

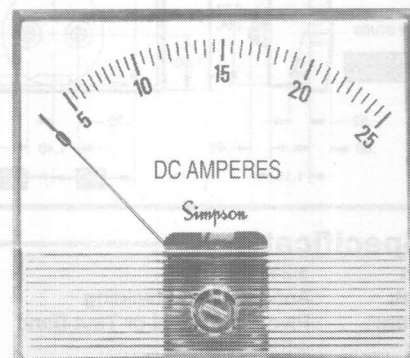
NOTE: For Bezel and Illumination Kit information please refer to Accessory Section of this Engineering Application Guide.



DC Current Meters

Tru-View Style

- Clear, Acrylic Windows
- Optional Bezel Kits
- Special Colored Scales or Logo Available
- $\pm 2\%$ Full Scale Accuracy
- Popular Sizes: 3-1/2" and 4-1/2"



Simpson's Tru-View family of analog panel meters offer a modern, clear acrylic front lens and clean, open scale to update your panel design. Tru-View panel meters provide reliable measurement of DC current up through 500 amps and are available in five popular sizes including: 1-1/2", 2-1/2", 3-1/2", 4-1/2", and 4x6" sizes. High range inputs require external current shunts (see Accessory Section). All meters are guaranteed to $\pm 2\%$ full scale accuracy and meet American National Standards Institute specification ANSI C39.1. Attractive, black satin, die cast bezels are available in 3-1/2 and 4-1/2 inch sizes for behind panel mounting. The annular movement with rugged spring-backed pivot-and-jewel or taut-band suspensions is self-

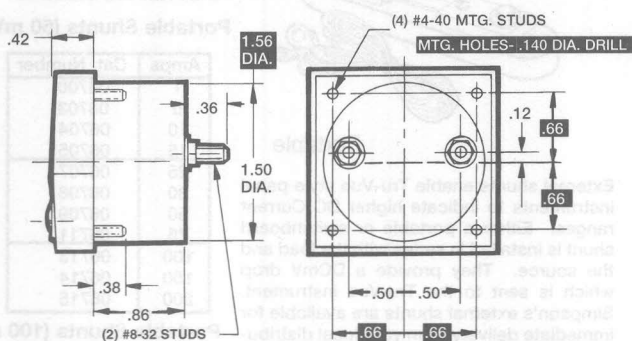
Model Number	Size	Meter Movement
921	1-1/2"	Annular
922	2-1/2"	Annular
923	3-1/2"	Annular
924	4-1/2"	Annular
926	4" x 6"	Annular

shielded from stray magnetic fields. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

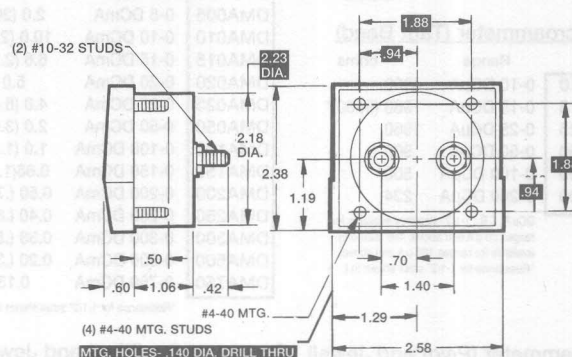
Dimensions

1 = Panel Meter Cut-out Dimensions

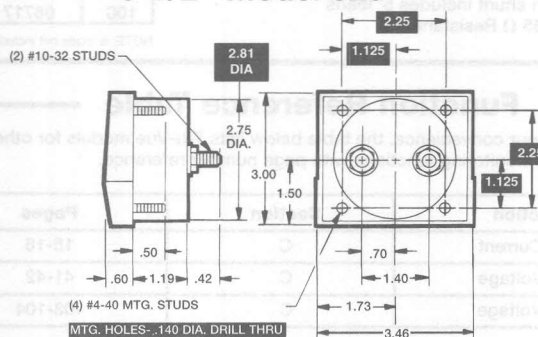
1-1/2"-Model 921



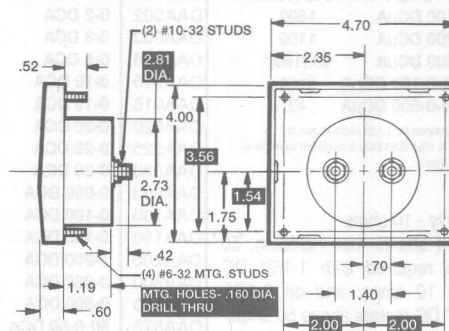
2-1/2"-Model 922



3-1/2"-Model 923



4-1/2"-Model 924



Tracking:

±0.7%

Response Time: 1.5 seconds maximum above 10 mA.**Overload (1 sec.)** 10 times full scale rating.**Overload (Continuous):** 1.5 times full scale rating**Shielding:** Calibration is unaffected by stray magnetic field or panel mounting.**Repeatability:** 2% Pivot and Jewel; 0.5% Taut Band**Dial:** Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used**Form:****Scale Length:** Knife edge, black matte finish
Model 921: 1.56" (39.62mm); 922: 2.40" (60.96mm); 923: 3.27" (83.06mm); 924: 3.92" (99.67mm); 926: 5.45" (138.43mm)**Net Weight:** Model 921: 1.5 oz (.04 kg)

Model 922: 4 oz (.11kg)

Model 923: 6 oz (.17kg)

Model 924: 8 oz (.22kg)

Model 926: 12 oz (.34kg)

Ordering Information

1 DMA 050

SIZE FUNCTION RANGE

1 1-1/2"

2 2-1/2"

3 3-1/2"

4 4-1/2"

5 4 x 6"

DC

Milliammeter (Pivot and Jewel)

	Range	≈ ohms
DMA001	0-1 DCmA	43
DMA003	0-3 DCmA	2.0
DMA005	0-5 DCmA	2.0 (20)*
DMA010	0-10 DCmA	10.0 (2.2)*
DMA015	0-15 DCmA	6.6 (2.2)*
DMA020	0-20 DCmA	5.0
DMA025	0-25 DCmA	4.0 (6.0)*
DMA050	0-50 DCmA	2.0 (3.0)*
DMA100	0-100 DCmA	1.0 (1.5)*
DMA150	0-150 DCmA	0.66 (1.0)*
DMA200	0-200 DCmA	0.50 (.75)*
DMA250	0-250 DCmA	0.40 (.60)*
DMA300	0-300 DCmA	0.33 (.50)*
DMA500	0-500 DCmA	0.20 (.30)*
DMA750	0-750 DCmA	0.13

*Resistance for 1-1/2" sizes shown in ()

Microammeter (Taut Band)

	Range	≈ ohms
TUA010	0-10 DCμA	4900
TUA015	0-15 DCμA	1960 (5500)*
TUA025	0-25 DCμA	1960
TUA050	0-50 DCμA	960
TUA100	0-100 DCμA	500
TUA200	0-200 DCμA	234

DCμA, T.B.: 1-1/2" size only available for ranges 50 μA and above, 4x6" size only available for ranges 100 μA and above.
*Resistance for 1-1/2" sizes shown in ()

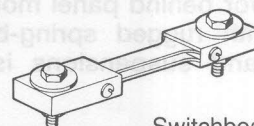
Microammeter (Pivot and Jewel) Current meter (Pivot and Jewel)

	Range	≈ ohms
DUA050	0-50 DCμA	1800 (5500)
DUA100	0-100 DCμA	1800
DUA200	0-200 DCμA	1100
DUA500	0-500 DCμA	90 (190)*
DUA1H1	100-0-100 DCμA	1100
DUA5H5	500-0-500 DCμA	43

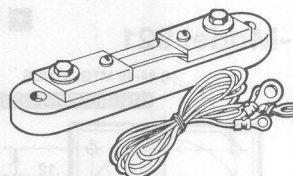
*Resistance for 1-1/2" sizes shown in ()
DCμA, P&J: 0-50 DCμA range not available in 4x6" size.

*1-1/2" sizes only - 10 ohms

External current shunts (not included), 50 mV drop, are required with 1-1/2" DC meters, above 10 amps; and on 2-1/2", 3-1/2" and 4x6" DC meters above 50 amps.

Accessories**External Portable and Switchboard Shunts**

Switchboard



Portable

Switchboard Shunts (50 mV)

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Portable Shunts (50 mV)

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts (100 mV)

Amps	Cat. Number
10	06716
100	06717

NOTE: 5' leads not included

External shunts enable Tru-View style panel instruments to indicate higher DC Current ranges. Either a portable or switchboard shunt is installed in series with the load and the source. They provide a DCmV drop which is sent to the Tru-View instrument. Simpson's external shunts are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Each shunt includes 5' leads
(0.065 Ω Resistance).

Function Reference Table

For your convenience, the table below lists Tru-View models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	15-16
AC Voltage	C	41-42
DC Voltage	C	103-104



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular Self-shielding; all models except Model 2121 and 2121T which is Small Core Magnet
Suspension: Models: 2121, 2122, 2123, 2124: Pivot and Jewel; Models: 2121T, 2122T, 2123T, 2124T: Taut Band
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%: Pivot and Jewel; 0.5%: Taut Band

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: High density black phenolic.
Pointer: Knife edge, with black matte finish.
Scale Length: Models 2121 & 2121T: 1.25" (31.7 mm)
 Models 2122 & 2122T: 2.07" (52.7 mm)
 Models 2123 & 2123T: 2.75" (69.8 mm)
 Models 2124 & 2124T: 4.09" (103.9 mm)
Net Weight: Models 2121 & 2121T: 2 oz. (0.06 kg)
 Models 2122 & 2122T: 7 oz. (0.20 kg)
 Models 2123 & 2123T: 8 oz (0.23 kg)
 Models 2124 & 2124T: 11 oz (0.31 kg)

Ordering Information

DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
0-50	1800 (5500)†	17815	17418	17499	17589
0-100	1800	17816	17420	17501	17591
0-200	1100	17818	17422	17503	17593
0-500	90 (190)†	17819	17424	17505	17595
25-0-25	1800 (5500)†	17820	<>	17506	17596
50-0-50	1800	17821	17425	17507	17597
100-0-100	1100	17822	17426	17508	17598
500-0-500	43	17823	17427	17509	17599

<> Available on special order.
 † Resistances of Model 2121 shown in ()

Taut-Band DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121T	2-1/2" Model 2122T	3-1/2" Model 2123T	4-1/2" Model 2124T
0-5	5750	—	—	17495	17585
0-10	4900	—	17415	17496	17586
0-15	1960	<>	17416	17497	17587
0-25	1960	<>	17417	17498	17588
0-50	960	<>	17419	17500	17590
0-100	500	<>	17421	17502	17592
0-200	234	<>	17423	<>	17594

<> Available on special order.

DC Galvanometers Self-Shielding Meter Movement

Range	Sensitivity μA	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
			1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
50-50-50	500-0-500	43	<>	17470	17558	<>
50-0-50	75-0-75	1800	<>	<>	17559	<>

<> Available on special order.

DC Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
0-1	43.0	17825	17430	17510	17600
0-3	2.0	<>	17431	17511	17601
0-5	2.0 (20)†	17826	17432	17512	17602
0-10	10.0 (2.2)†	17827	17433	17513	17603
0-15	6.6 (2.2)†	17828	17434	<>	<>
0-20	5.0	<>	<>	17515	<>
0-25	4.0 (6.0)†	17829	17436	17516	17606
0-50	2.0 (3.0)†	17830	17437	17517	17607
0-100	1.0 (1.5)†	17832	17438	17518	17608
0-150	.66 (1.0)†	17833	17439	17519	17609
0-200	.50 (.75)†	17834	17440	17520	17610
0-250	.40 (.60)†	17835	17441	17521	17611
0-300	.33 (.50)†	17836	17442	17522	17612
0500	.20 (.30)†	17837	17443	17523	17613
0-750	.13	<>	<>	17524	17614
0-1000	.05	<>	17444	<>	17615

<> Available on special order. † Resistances of Model 2121 shown in ()

DC Current meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
0-1	.050	17800	17400	17475	17565
0-1.5	.003	<>	17401	17476	<>
0-2	.025	17801	17402	17477	17567
0-3	.0166	17802	17403	17478	17568
0-5	.010	17803	17404	17479	17569
0-10	.005	17805	17405	17480	17570
0-15	.0033	17806†	17406	17481	17571
0-25	.0020	17807†	17407	17482	17572
0-30	.0017	<>	17408	17483	17573
0-50	.001	17808†	17409	17484	17574
0-100	10.0	<>	17410†	17485†	17575†
0-150	10.0	<>	<>	17486†	17576†
0-200	10.0	<>	17412†	17487†	17577†
0-300	10.0	<>	<>	17488†	17578†
0-500	10.0	<>	<>	17489†	17579†
15-0-15	.0033	<>	<>	17490	<>
30-0-30	.0017	<>	<>	17491	<>

† 1-1/2" DC current meters are self-contained through 10 amps. 15 amps and higher are supplied as 50 mV meters to be used with external shunts. 2-1/2", 3-1/2" and 4-1/2" DC current meters are self-contained through 50 amps. Higher range DC current meters are 50 mV meters to be used with external shunts. <> Available on special order.

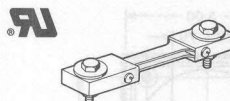
Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

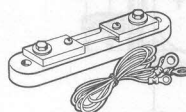
Function	Section	Pages
DC Voltage	C	105-106
AC Voltage	C	43-44
AC Current	C	17-18
RF Current	C	161-162
Decibels	C	131-132
VU	C	171-172
Watts	C	182-183

Accessories

External Portable and Switchboard Shunts



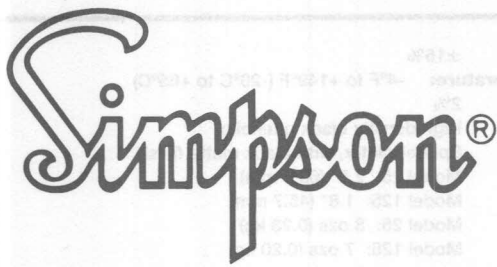
Switchboard



Portable

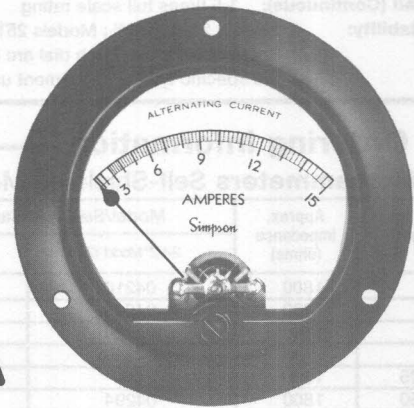
These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Please refer to the Accessory Section of this Engineering Application Guide for detail and ordering information.



DC Current Meters

Round Style



- **±2% Full Scale Accuracy**
- **Calibration Not Affected By Steel Mounting**
- **UL Recognized**
- **Distinctive Case Style**
- **Phenolic Case with Glass Windows**
- **Two Popular Sizes: 2-1/2" & 3-1/2"**

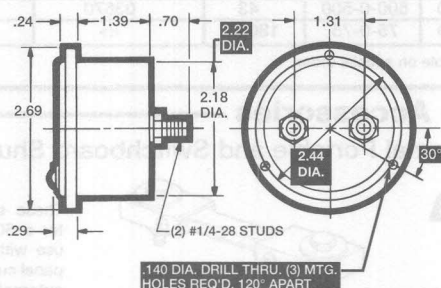
For industrial or commercial applications, the Round style panel meter offers maximum reliability and ±2% full scale accuracy. With a black phenolic case and glass window for optimum viewing, the Round style meter is a popular replacement. All DC units have pivot and jewel suspensions that are spring-loaded for shock protection. The self-shielded meter movement prevents magnetic interaction between the meter and a steel panel. Two popular sizes of 2-1/2" and 3-1/2" are available to measure various voltage ranges up to 1000 amps. DC current meters are self contained for ranges up to and including 50 amperes. Higher range DC cur-

rent meters require external shunts mentioned herein. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
125, 125T	2-1/2"	Self-Shielding
25, 25T	3-1/2"	Self-Shielding

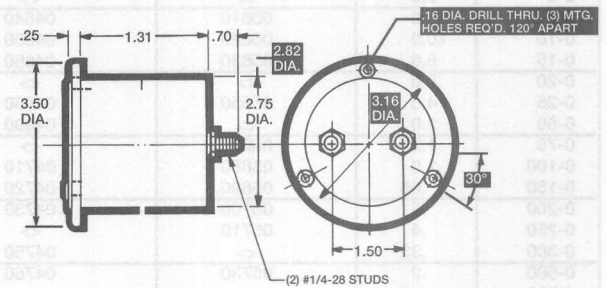
Dimensions and Compatibility

2-1/2"-Model 125 & 125T



Note: Dimensions Are Also Used For Model 125

3-1/2"-Model 25 & 25T



NOTE: "T" model suffix used for Taut-Band movement

Compatibility Reference Table

Manufacturer	Size/Model	
	2-1/2"	3-1/2"
Beede	501	310
Hoyt	17/3	583
Triplet		
S Series	221-T	
Weston		
200 and 300	201	301

0-200	1100	04230	03780
0-500	90	04240	03790
25-0-25	1800	<>	<>
50-0-50	1800	04294	03810
100-0-100	1100	04296	03820
500-0-500	43	<>	03830

<> Available on special order.

Taut-Band DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		2-1/2" Model 125T	3-1/2" Model 25T
0-5	5750	<>	03738
0-10	4900	04197	<>
0-15	1960	<>	03741
0-25	1960	04201	03751
0-50	960	<>	03761
0-100	500	<>	03771

<> Available on special order.

DC Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		2-1/2" Model 125	3-1/2" Model 25
0-1	43.0	05580	04610
0-1.5	43.0	<>	04620
0-3	2.0	<>	<>
0-5	2.0	05610	04640
0-10	10.0	05620	04650
0-15	6.6	05630	04660
0-20	5.0	<>	<>
0-25	4.0	05650	04680
0-50	2.0	<>	04690
0-75	1.3	05670	<>
0-100	1.0	05680	04710
0-150	.66	05690	04720
0-200	.5	05700	04730
0-250	.4	05710	<>
0-300	.33	<>	04750
0-500	.2	05730	04760
0-750	.13	<>	<>
0-1000	.05	<>	04780

<> Available on special order.

Function Reference Table

For your convenience, the table below lists Round models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	19-20
AC Voltage	C	45-46
DC Voltage	C	107-108
Decibels	C	133-134
RF Current	C	163-164
Watts	C	184-185

0-2	.025	<>	00030
0-3	.0166	01490	00040
0-5	.010	01500	00050
0-10	.005	01510	00060
0-15	.0033	01520	00070
0-25	.0020	01530	00080
0-30	.0017	01540	00090
0-50	.001	01550	00099
0-75	10.0	01560†	00110†
0-100	10.0	01570†	00120†
0-150	10.0	01580†	00130†
0-200	10.0	01590†	00140†
0-250	10.0	<>	00151†
0-300	10.0	01610†	00160†
0-500	10.0	01620†	00170†
0-750	10.0	<>	00177†
0-1000	10.0	<>	00188†
15-0-15	.0033	<>	00200
30-0-30	.0017	01660	00210
50-0-50	.001	01670	00220

† DC current meters are self-contained for ranges up to and including 50 amperes. Higher range DC current meters (50 mV) listed above are calibrated for 5' leads and require external shunts. <> Available on special order.

DC Galvanometers Self-Shielding Meter Movement

Range	Sensitivity μ A	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
			2-1/2" Model 125	3-1/2" Model 25
50-0-50	500-0-500	43	03670	03630
50-0-50	75-0-75	1800	<>	<>

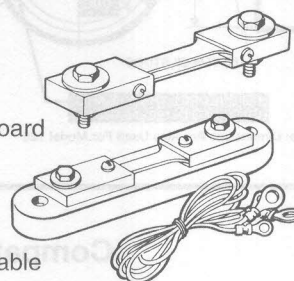
<> Available on special order.

Accessories

External Portable and Switchboard Shunts



Switchboard



Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Portable Shunts 50 mV

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

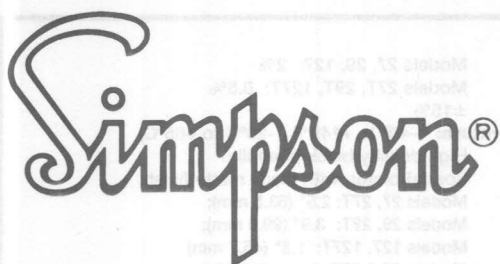
Portable Shunts 100 mV

Amps	Cat. Number
10	06716
100	06717

NOTE: 5' leads not included

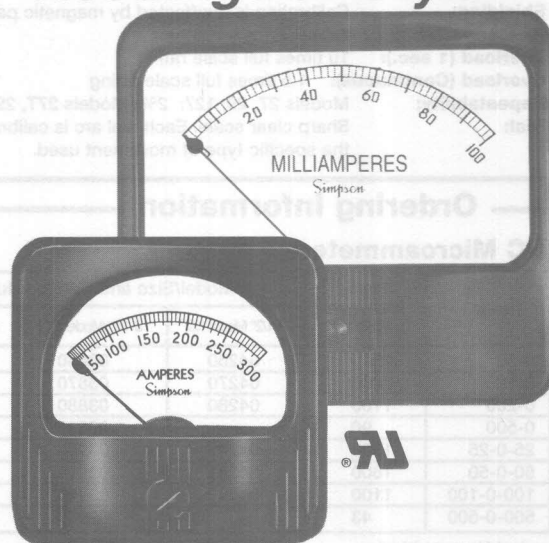
Switchboard Shunts 50 mV

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Meters

Rectangular Style



- **±2% of Full Scale Accuracy**
- **Calibration Not Affected by Steel Panels**
- **UL Recognized**
- **Distinctive Case Style**
- **Phenolic Case With Glass Windows**
- **Three popular sizes: 2-1/2", 3-1/2", 4-1/2"**

For industrial or commercial applications, the Rectangular style panel meter offers maximum reliability and ±2% full scale accuracy. With a black phenolic case and glass window for optimum viewing, the Rectangular style meter is a popular replacement. DC units are available in either the standard pivot and jewel or taut-band suspension which provides optimum band length for shock protection. The self-shielded meter movement prevents magnetic interaction between the meter and a steel panel. Three popular sizes of 2-1/2", 3-1/2", and 4-1/2" are available to measure varying cur-

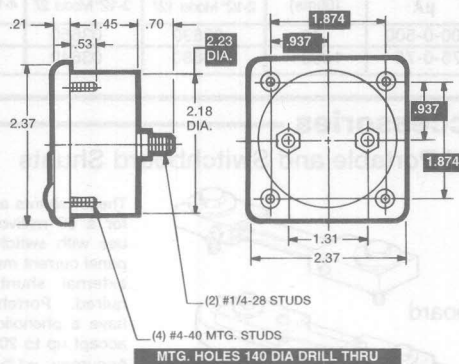
rent ranges. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
127, 127T	2-1/2"	Annular
27, 27T	3-1/2"	Annular
29, 29T	4-1/2"	Annular

Dimensions and Compatibility

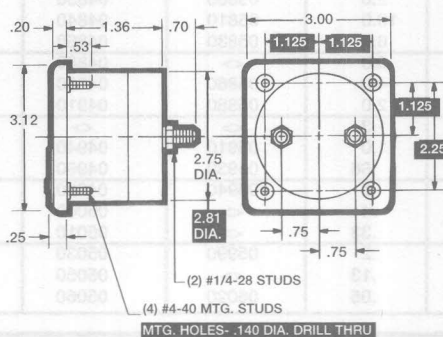
2-1/2"-Models 127 & 127T

1 = Panel Meter Cut-out Dimensions

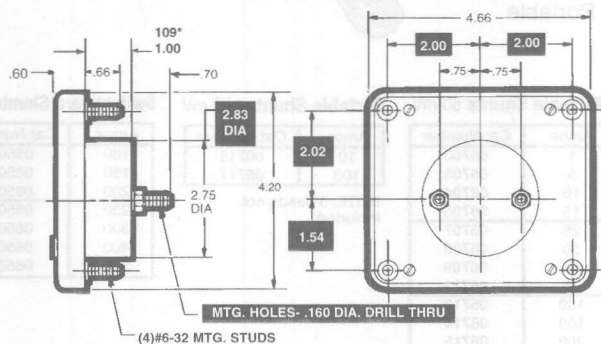


NOTE: "T" model suffix used for Taut-Band movement

3-1/2"-Models 27 & 27T



4-1/2"-Models 29 & 29T



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Beede		15	16/458
Hoyt		598	648/684
Modutec PB Series	2PB*	3PB*	4PB
Triplett S Series	227-T	327-*T	420
Yokogawa Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1

*Modutec Meters use a three-stud mount.

Specifications

Accuracy:	±2% F.S.
Movement:	Annular-Self-shielding
Suspension:	Models 27, 29, 127: Pivot and Jewel Models 27T, 29T, 127T: Taut Band
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	Models 27, 29, 127: 2%; Models 27T, 29T, 127T: 0.5%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Repeatability:	Models 27, 29, 127: 2% Models 27T, 29T, 127T: 0.5%
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	SpadePointer, with black matte finish.
Scale Length:	Models 27, 27T: 2.5" (63.5 mm); Models 29, 29T: 3.9" (99.0 mm); Models 127, 127T: 1.8" (45.7 mm)
Net Weight:	Models 27 & 27T: 8 ozs (0.23Kg); Models 29 & 29T: 11 ozs (0.31 Kg); Models 127 & 127T: 7 ozs (0.20 Kg)

Ordering Information

DC Microammeters

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
0-50	1800	04260	03860	03960
0-100	1800	04270	03870	03970
0-200	1100	04280	03880	03980
0-500	90	<>	03890	03990
25-0-25	1800	04243	03900	04000
50-0-50	1800	04245	03910	04010
100-0-100	1100	04247	03920	04020
500-0-500	43	<>	03930	04030

<> Available on special order.

Taut-Band DC Microammeters

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127T	3-1/2" Model 27T	4-1/2" Model 29T
0-5	5750	<>	03838	03938
0-10	4900	04246	03839	03939
0-15	1960	04248	03841	03941
0-25	1960	04251	03851	03951
0-50	960	04261	03861	03961
0-100	500	<>	03871	03971

DC Milliammeters

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
0-1	43.0	05760	04790	05070
0-1.5	43.0	<>	04810	05080
0-3	2.0	05790	04820	05090
0-5	2.0	05800	04830	05100
0-10	10.0	05810	04840	05110
0-15	6.6	05830	04860	05120
0-20	5.0	<>	04880	05130
0-25	4.0	05860	04890	05140
0-50	2.0	05880	04910	05150
0-75	1.3	<>	<>	<>
0-100	1.0	05910	04940	05170
0-150	.66	05930	04960	05180
0-200	.5	05940	04980	05190
0-250	.4	<>	05000	05200
0-300	.33	<>	05010	05210
0-500	.2	05990	05030	05220
0-750	.13	<>	05050	05230
0-1000	.05	06020	05060	05240

Function Reference Table

For your convenience, the table below lists Rectangular models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Current	C	21-22
AC Voltage	C	47-48
DC Voltage	C	109-110
Decibels	C	135-136
RF Current	C	165-166
VU	C	173-174
Watts	C	185-186

DC Current Meters

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
0-1	.050	01680	00230	00450
0-1.5	.033	01690	00240	00460
0-2	.025	01709	00250	00470
0-3	.0166	01710	00260	00480
0-5	.010	01720	00270	00490
0-10	.005	01730	00280	00500
0-15	.0033	01740	00290	00512
0-25	.0020	01750	00300	00520
0-30	.0017	01760	00310	00530
0-50	.001	01770	00320	00540
0-75	10.0	01780†	00330†	00550†
0-100	10.0	01790†	00340†	00560†
0-150	10.0	01800†	00350†	00570†
0-200	10.0	01810†	<>	00580†
0-250	10.0	<>	<>	00590†
0-300	10.0	<>	00380†	00600†
0-500	10.0	<>	00390†	00610†
0-750	10.0	<>	00400†	00620†
0-1000	10.0	<>	00410†	00630†
15-0-15	.0033	<>	<>	00640
30-0-30	.0017	01880	00430	00650
50-0-50	.001	01890	00440	00660

† DC current meters are self-contained for ranges up to and including 50 amperes. Higher range DC current meters (50 mV) listed above are calibrated for 5 ft. leads and require external shunts, described below.

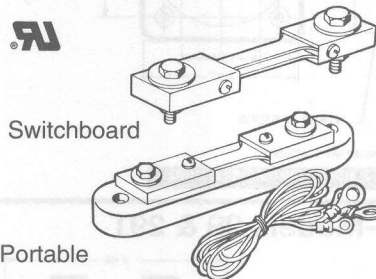
<> Available on special order.

DC Galvanometers

Range	Sensitivity μ A	Approx. Impedance (ohms)	Model/Size and Catalog Number		
			2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
50-0-50	500-0-500	43	03690	03650	03654
50-0-50	75-0-75	1800	03680	03640	03652

Accessories

External Portable and Switchboard Shunts



These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Portable Shunts 50 mV

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts 100 mV

Amps	Cat.Number
10	06716
100	06717

NOTE: 5' leads not included

Switchboard Shunts 50 mV

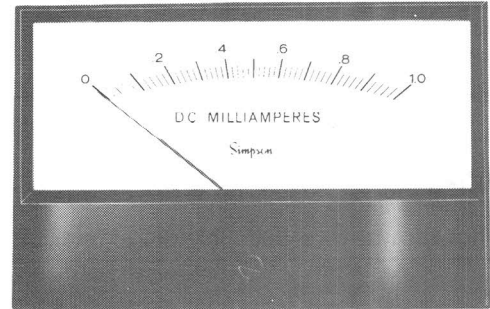
Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Meters

Designer Style

- **Clean, Uncluttered Look**
- **Phenolic Cases With Glass Windows**
- **Maximum Readability in Minimum Required Height**
- **Two Popular Sizes: 3-1/2", 4-1/2"**
- **Calibration Not Affected When Mounted on Steel Panels**



Model Number	Size	Meter Movement
523	3-1/2"	Annular
524	4-1/2"	Annular

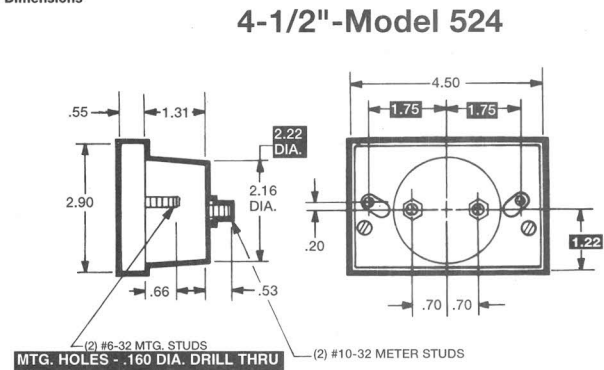
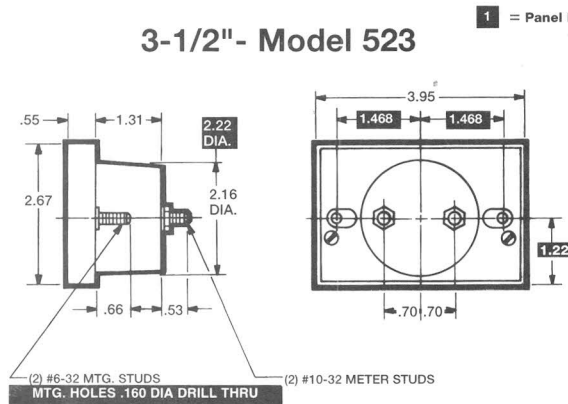
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1

Look to the Designer Series to be used in today's compact equipment designs — without sacrificing readability. The professional styling of Designer meters offered by Simpson take up less than 3 inches of panel height, yet the scale is over 3-1/2 inches long.

With a black phenolic case and glass window for optimum viewing, the Designer has a red knife-edge pointer, providing excellent readability and ± 2 percent of full scale accuracy. The 3-1/2" and 4-1/2" sizes available, feature a self-shielding meter movement which prevents interaction between the meter and a steel panel.

Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

Dimensions and Compatibility



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Hoyt	2135	2145
Triplett R Series	320-R	420-R

Specifications

Accuracy:	±2% F.S.
Movement:	Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	White with black printing. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	Black phenolic with glass window
Pointer:	Red, knife edge
Scale Length:	Model 523: 2.92" (74.2 mm) Model 524: 3.25" (82.5 mm)
Net Weight:	Model 523: 9 ozs (0.26 kg) Model 524: 10 ozs (0.28 kg)

Ordering Information

DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number	
		3-1/2" Model 523	4-1/2" Model 524
0-15	1960	15014	15092
0-25	2100	15015	15085
0-50	1800	15017	15087
0-100	1800	15019	15089
0-200	1100	15021	15091
0-500	90	15022	15093
25-0-25	1800	15023	15094
50-0-50	1800	15025	15095
100-0-100	1100	15027	15097
500-0-500	43	15024	15096

DC Milliammeters Self-Shielding Meter Movement

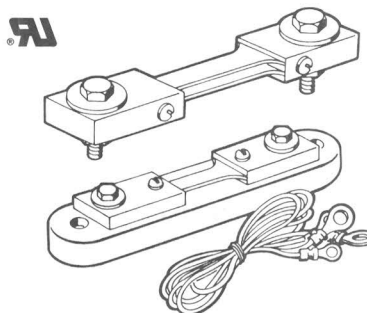
Range	Approx. Impedance (ohms)	Model/Size and Catalog Number	
		3-1/2" Model 523	4-1/2" Model 524
0-1	43.0	15000	15070
0-5	2.0	15001	15076
0-10	10.0	15002	15077
0-50	2.0	15003	15078
0-100	1.0	15010	15080
0-200	0.5	15004	15079
0-300	0.33	15012	15081
0-500	0.2	15013	15082

DC Current Meters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number	
		3-1/2" Model 523	4-1/2" Model 524
0-1	.050	15031	15101
0-3	.0166	15032	15102
0-5	.010	15033	15103
0-10	.005	15030	15100
0-15	.0033	15034	15104
0-25	.0020	15035	15105
0-50	.001	15036	15106

Accessories

External Portable and Switchboard Shunts



Switchboard

Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy ±1%, 5' leads (0.065 Ω resistance) included.

Portable 50 mV Shunts

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat. Number
10	06716
100	06717

5' leads not included

Switchboard 50 mV Shunts

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Function Reference Table

For your convenience, the table below lists Designer models for other electrical monitoring functions and page reference.

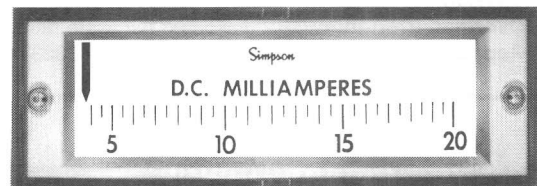
Function	Section	Pages
AC Current	C	23-24
AC Voltage	C	49-50
DC Voltage	C	111-112
VU	C	175-176



DC Current Meters

Edgewise 3-1/2" Style

- **Compact and Lightweight**
- **Dustproof, Molded Acrylic Case**
- **Accuracy at $\pm 2\%$ of Full Scale ($\pm 1\%$ Available on Special Order)**
- **Horizontal Mounting, Vertical on Special Order**
- **Zero Adjust From Front Panel (Except on 4-20 mA Units)**
- **Self-Shielding Core Magnet Movement**



Model Number	Size	Meter Movement
3623	3-1/2"	Shallow Core Magnet
3623T	3-1/2"	Taut Band

Simpson's Model 3623 Edgewise panel meter has been designed to satisfy the increasing demand for an attractive and accurate analog display in a minimum of panel space. The pivot and jewel suspension Edgewise meter provides a number of user benefits in solving many design panel problems such as front bezel zero adjust (except on 4-20mA units) with maximum dial visibility, unsurpassed stability and optimum performance.

A unique Simpson self-shielding 1-15/16" shallow core magnet movement provides $\pm 2\%$ full scale standard accuracy or optional $\pm 1\%$ full scale accuracy for either horizontal or vertical (special order) scale orientations.

The 3-1/2" Edgewise meter is supplied with mounting hardware and bezel. Panel mounting is quick and easy. A front bezel Allen screw operates a lock, which slides across a wedge-shaped cam surface, locking the instrument in place. When removing, the lock recesses into a slot on the side of the instrument. No additional mounting hardware is required.

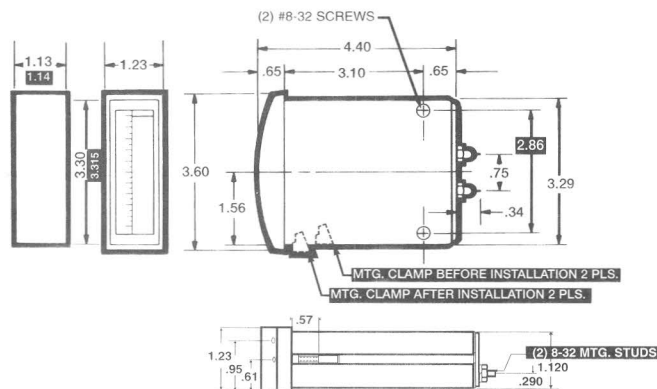
This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

3-1/2"-Models 3623 & 3623T

NOTE: "T" model suffix used for Taut-Band movement



Compatibility Reference Table

Manufacturer	Size/Model
	3-1/2"
Triplett	
E Series	320-EG
Weston	231

Specifications

Accuracy: $\pm 2\%$ F.S. ($\pm 1\%$ special order)
Movement: Shallow Core Magnet, Self-Shielding
Suspension: Taut Band or Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: Model 3623: 2%; Model 3623T: 0.5%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
 Standard dial is white with black printing.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Steel top and bottom with Valox Polyester frame and acrylic window.
Pointer: Black, Lance Pointer
Scale Length: 2.6" (66 mm)

Ordering Information

DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number
		3-1/2" Model 3623
0-200 μA DC	400	16865
0-500 μA DC	166	16866
25-0-25 μA DC	1010	16867

DC Microammeters Taut- Band Meter Movement

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number
		3-1/2" Model 3623T
0-25 μA DC	2730	16862
0-50 μA DC	1010	16863
0-100 μA DC	400	16864

DC Milliammeters

Range	Approx. Impedance (ohms)	Model/Size and Catalog Number
		3-1/2" Model 3623
0-1 mA DC	62	16868
4-20 mA DC	1	16869

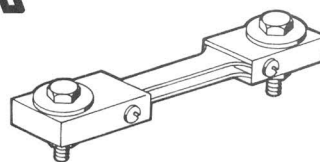
Function Reference Table

For your convenience, the table below list Edgewise models for other electrical monitoring functions and page reference.

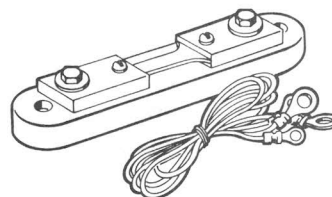
Function	Section	Pages
AC Current	C	25-26
AC Voltage	C	51-52
DC Voltage	C	113-114

Accessories

External Portable and Switchboard Shunts



Switchboard



Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Portable 50 mV Shunts

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat.Number
10	06716
100	06717

5' leads not included

Switchboard 50 mV Shunts

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Where panel meter designs call for making every square inch count or when weight saving is important, the Edgewise Barrel meters solve these design problems and many more. Its self-shielding, core magnet meter movement provides $\pm 2\%$ F.S. accuracy for either vertical or horizontal scale orientations with unsurpassed stability. This type of movement structure prevents magnetic interaction between meters and the mounting panel. The pivot and jewel suspension is spring-loaded for shock protection. A high impact molded acrylic case design is dustproof for optimum performance in less than ideal environments. The Edgewise Barrel meter is supplied with complete

Model Number	Size	Meter Movement
1521	1-1/2"	Small Core Magnet
1522	2-1/2"	Small Core Magnet

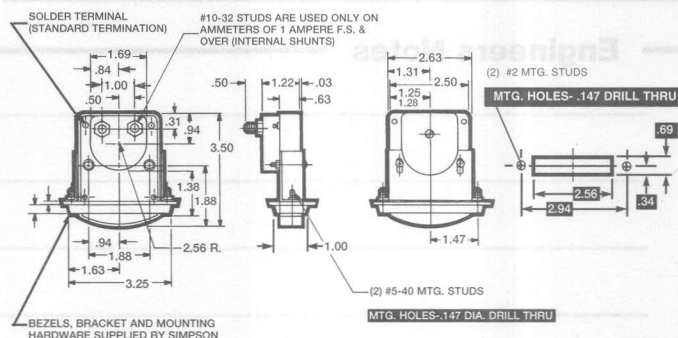
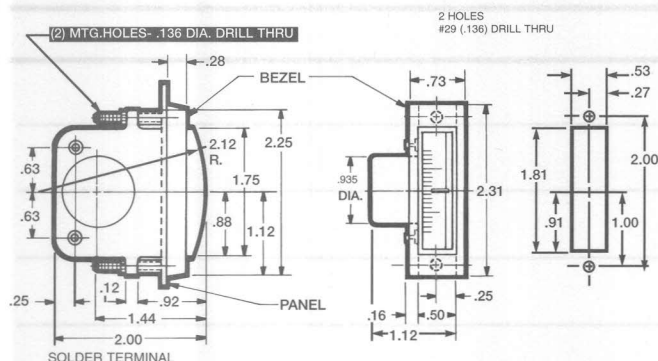
mounting hardware and bezel. Two popular sizes of 1-1/2" and 2-1/2" are available in two standard ranges for DC current. This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions

1-1/2"- Model 1521

1 = Panel Meter Cut-out Dimensions

2-1/2"- Model 1522



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Small Core Magnet type, Self-shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: Molded Acrylic
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Repeatability: 2%
Pointer: Lance, with red matte finish
Scale Length: Model 1521: 1.375" (35 mm)
 Model 1522: 1.875" (47.6 mm)
Net Weight: Model 1521: 2 oz. (0.06 kg)
 Model 1522: 4 oz. (0.11 kg)

C
8
6

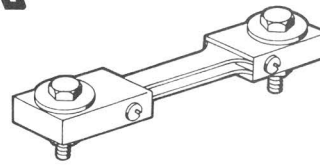
Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		1-1/2" Model 1521	2-1/2" Model 1522
0-5	.010	—	03390
0-25	.002	—	03420

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		1-1/2" Model 1521	2-1/2" Model 1522
0-25	3150.0	—	04560
0-50	1800.0	04553	04570
0-100	1100.0	04554	04580
0-200	290.0	04555	04590
0-500	90.0	04556	04600

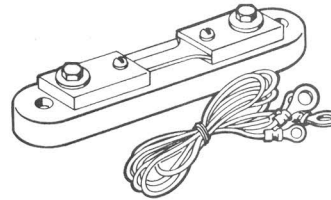
Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		1-1/2" Model 1521	2-1/2" Model 1522
0-1	20.0	06811	06710
0-5	2.5	06812	06720
0-10	13.5	06813	06730
0-25	5.4	06815	06740
0-50	2.7	06816	06750
0-100	1.35	06817	06760
0-200	.49	06818	<>
0-500	.27	06819	06810

Function Reference Table

Function	Section	Pages
AC Voltage	C	53-54
DC Voltage	C	115-116
VU	C	177-178



Switchboard



Portable

Portable 50 mV Shunts

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat.Number
10	06716
100	06717

5' leads not included

Switchboard 50 mV Shunts

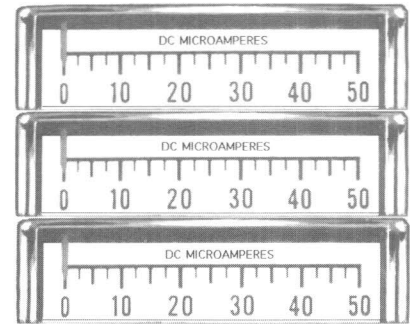
Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Engineers Notes



DC Current Meters

Edgewise Stackable



- Compact and Lightweight
- Dustproof Construction
- Steel Housing
- Rustproof Finish
- Two sizes: 1-1/2", 2-1/2"

Model Number	Size	Meter Movement
1921	1-1/2"	Thin core
1622	2-1/2"	Magnet-Self shielding

C
8
7

Simpson's Edgewise stackable panel meters have a unique thin core magnet movement that eliminates the protruding barrel which is prevalent in other edgewise meter designs. It is modern and extremely compact, and is supplied with mounting hardware and bezel. The rugged steel case has a rustproof finish and a dustproof construction for optimum performance in less than ideal environments. The self-shielded meter movement provides $\pm 2\%$ full scale accuracy. The scale extends nearly to the full width and height of the meter.

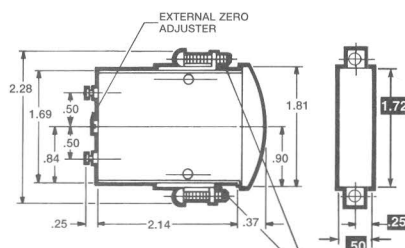
An optimum scale display area permits the use of large easy-to-read numerals on a horizontal plane.

This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility

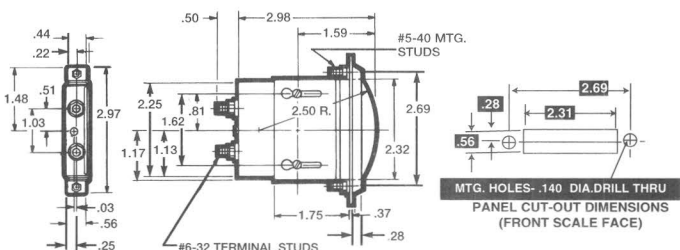
1-1/2"- Model 1921

1 = Panel Meter Cut-out Dimensions



2 REMOVABLE METER BRACKET ASSEMBLIES. BRACKET ASSEMBLIES ARE ADJUSTABLE, SO METERS CAN BE MOUNTED ON PANELS UP TO 9/32" THICK

2-1/2"-Model 1622



Compatibility Reference Table

Manufacturer	Size/Model
	1-1/2"
Crompton	170 Series

Specifications

Accuracy:	±2% F.S.
Movement:	Thin core magnet, Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	Steel housing with rustproof finish
Pointer:	Red, lance pointer
Scale Length:	Model 1921: 1.37" (35.8 mm) Model 1622: 1.85" (47.0 mm)
Net Weight:	Model 1921 3 ozs (0.08 kg) Model 1622 5 oz. (0.14 kg)

Ordering Information

DC Microammeters Self-Shielding Meter

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		1-1/2" Model 1921	2-1/2" Model 1622
0-25	8470	<>	18035
0-50	2020	<>	18036
0-100	1060	<>	18037
0-200	310	<>	<>
0-500	63	<>	18039

DC Milliammeters

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		1-1/2" Model 1921	2-1/2" Model 1622
0-1	18.0	18012	18019
0-5	2.0	18013	18020
0-10	5.0	18014	<>
0-25	2.0	18015	18022
0-50	1.0	<>	<>
0-100	.5	<>	<>
0-500	.1	<>	<>

<> Available on special order

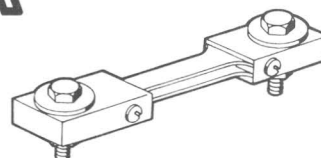
Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

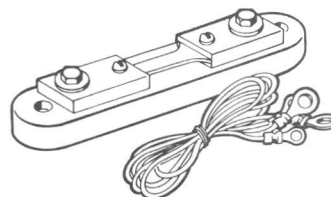
Function	Section	Pages
AC Voltage	C	55-56
DC Voltage	C	117-118

Accessories

External Portable and Switchboard Shunts



Switchboard



Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy ±1%, 5' leads (0.065 Ω resistance) included.

Portable 50 mV Shunts

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat.Number
10	06716
100	06717

5' leads not included

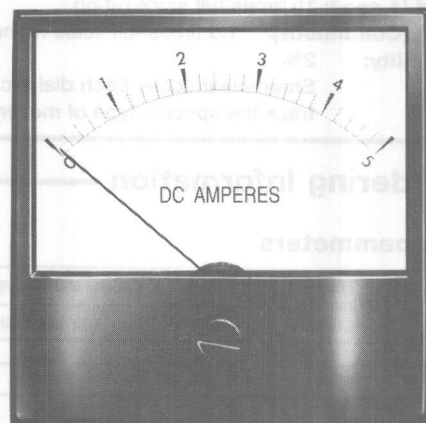
Switchboard 50 mV Shunts

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Meters

Rugged Seal Style



Model Number	Size	Meter Movement
3323	3-1/2"	Annular
3324	4-1/2"	Annular
3326	4x6"	Annular

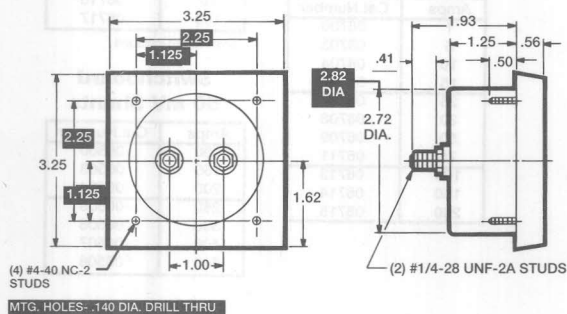
- Rugged Metal Case for Rigorous Environments
- O-Ring Sealed Zero Adjust and Electrical Terminals
- Commercially Sealed, Moisture and Dustproof
- Three sizes: 3-1/2", 4-1/2", 4x6"
- Calibration not Affected by Steel Panel Mounting

Specifically designed for harsh environments, Simpson's Rugged Seal panel meters are ideal for use in field test equipment or wherever rigorous environmental conditions are encountered. This line of panel meters offers a stylish look with its black metal case and clear glass window. The metal case gives complete magnetic isolation which is especially important in steel panel mounting where stray magnetic fields can induce errors in your reading. In addition, each meter is moisture, dirt, and dustproof. For applications where wash down of control panels is necessary, the Rugged Seal meters are splash proof and offer excellent resistance to water. For added environmental protection, both zero adjust and electrical terminals are O-

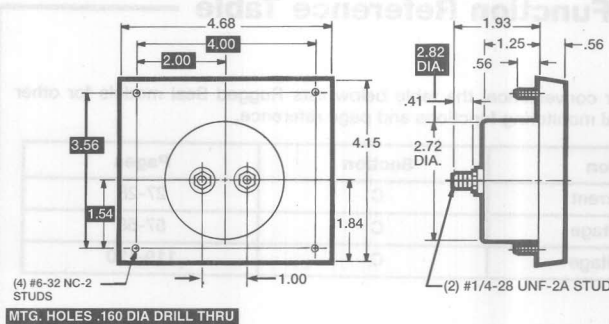
ring sealed. The Rugged Seal meters are available in three convenient sizes; 3-1/2", 4-1/2", and 4x6". All DC units feature self-shielding meter movements and $\pm 2\%$ full scale accuracy. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Dimensions and Compatibility

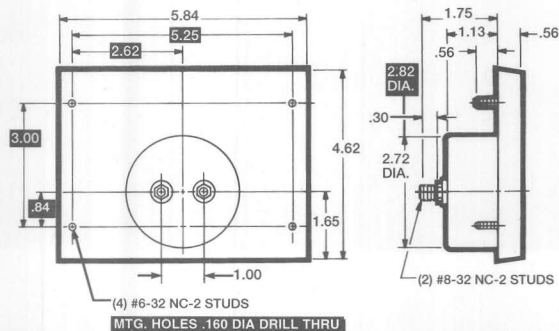
3-1/2"-Model 3323



4-1/2"-Model 3324



4x6"-Model 3326



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec K Series	K3-	K4-

Specifications

Accuracy:	±2% F.S.
Movement:	Annular, self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	Metal Cover with Black Matte Finish Trim
Pointer:	Knife Edge with Black Matte Finish
Scale Length:	Model 3323: 2.74" (70.0 mm) Model 3324: 4.05" (103.0 mm) Model 3326: 4.94" (125.0 mm)
Net Weight:	Model 3323: 12 ozs (0.340 Kg) Model 3324: 17 ozs (0.48 Kg) Model 3326: 19 ozs (0.54 Kg)

Ordering Information

DC Microammeters

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 3323	4-1/2" Model 3324	4x6" Model 3326
0-50	3000	16055	16150	16245
0-100	1450	16060	16155	16250

DC Milliammeters

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 3323	4-1/2" Model 3324	4x6" Model 3326
0-1	80	16045	16140	16235

DC Current Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 3323	4-1/2" Model 3324	4x6" Model 3326
0-5	Internal Shunt	16035	<>	<>
0-10	75 mV max.	16040	<>	<>

<> Available on special order.

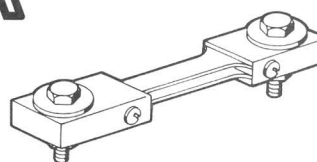
Function Reference Table

For your convenience, the table below lists Rugged Seal models for other electrical monitoring functions and page reference.

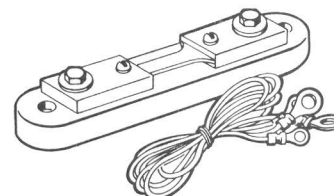
Function	Section	Pages
AC Current	C	27-28
AC Voltage	C	57-58
DC Voltage	C	119-120

Accessories

External Portable and Switchboard Shunts



Switchboard



Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy ±1%, 5' leads (0.065 Ω resistance) included.

Portable 50 mV Shunts

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat.Number
10	06716
100	06717

5' leads not included

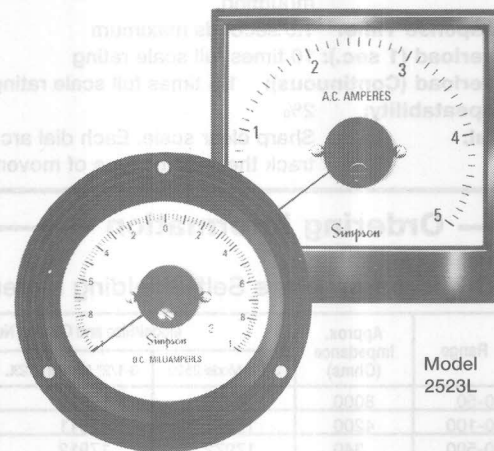
Switchboard 50 mV Shunts

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Meters

250° Long Scale



■ More than Double the Scale Length

■ Phenolic and Shielded Metal Cases

■ Glass Windows

■ Two sizes: 3-1/2", 4-1/2"

■ Zero Adjust From Front Panel

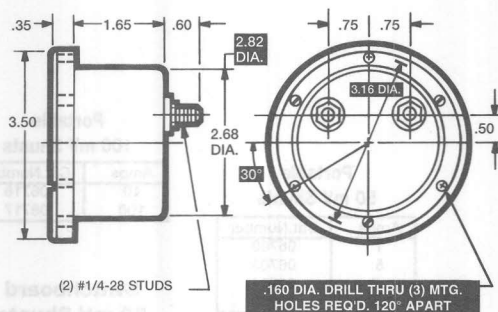
Look to the 250° Long Scale analog meters for a full 250° readability that provides more than double the scale length of the standard 90° or 100° movements. Simpson's 250° panel meters are designed for applications that require high-resolution readings all in a compact and attractive design. They are self-shielded, permanent magnet, moving coil instruments with nonmagnetic pivots and spring-backed jewels. The movement construction allows meter to be mounted on steel panels. These easy-to-read instruments are available in either sealed round metal or in molded square phenolic cases with glass windows. The zero adjust is conveniently

located on the external front portion of the meter. Two different standard sizes of 3-1/2" and 4-1/2" are available in selected current ranges. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
2523	3-1/2"	Self-shielding
2123L	3-1/2"	Self-shielding
2524	4-1/2"	Self-shielding

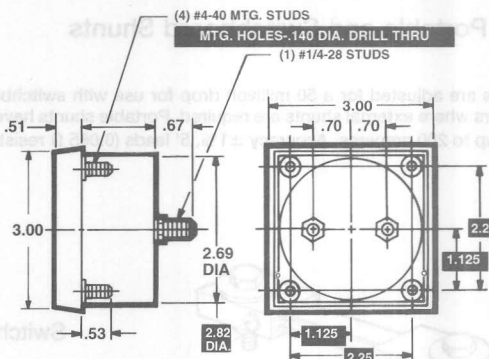
Dimensions and Compatibility

3-1/2"-Model 2523

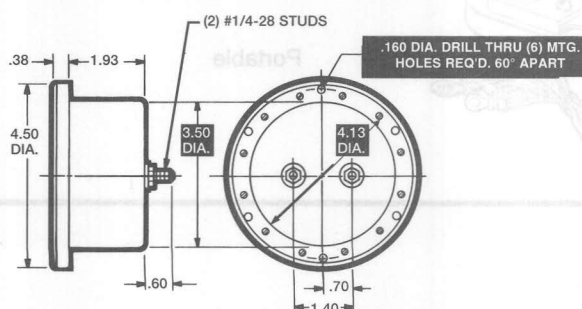


1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 2123L



4-1/2"-Model 2524



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Self-shielded, permanent magnet
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Models 2523 & 2524: Round metal
 Model 2123L: Square, black phenolic
 Red, Knife Edge.
Pointer:
Scale Length: Models 2523, 2123L: 4.77" (121.16 mm)
 Model 2524: 6.54" (63.0 mm)
Net Weight: Models 2523 & 2123L: 8 oz (230 g)
 Model 2524: 9 oz (260 g)

Ordering Information

DC Microammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 2523	3-1/2" Model 2123L	4-1/2" Model 2524
0-50	8000	17970	17910	17980
0-100	4200	17971	17911	17981
0-500	340	17972	17912	17982

DC Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 2523	3-1/2" Model 2123L	4-1/2" Model 2524
0-1	135.0	17973	17913	17983
0-10	10.0	17974	<>	17984
0-500	0.2	17975	<>	17985
1-0-1	50.0	17996	<>	17997

<> Available on special order.

DC Current Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 2523	3-1/2" Model 2123L	4-1/2" Model 2524
0-10	.005	17976	<>	17986

<> Available on special order.

Function Reference Table

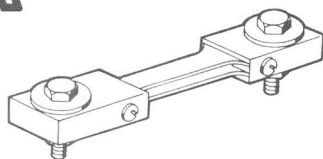
For your convenience, the table below lists 250° Long Scale models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	29-30
AC Voltage	C	61-62
DC Voltage	C	121-122

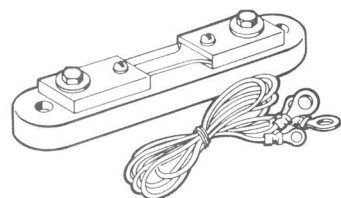
Accessories

External Portable and Switchboard Shunts

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have Phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.



Switchboard



Portable

Portable 50 mV Shunts

Amps	Cat. Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat. Number
10	06716
100	06717

Switchboard 50 mV Shunts

Amps	Cat. Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



DC Current Meters

Edgewise Controller

- $\pm 2\%$ Standard Accuracy ($\pm 1\%$ Accuracy Special Order)
- Pivot and Jewel Suspension
- Double or Single Setpoints
- Mode Indication Lamps
- Stacked or Individually Mounted
- Horizontal Mounting (Vertical Mounting On Special Order)
- Control Switching Within 1.0% F.S. of Setpoints
- Integral Mounting Lock for Easy Installation
- Removable Set Knobs



Model Number	Size	Meter Movement
3623XO	3-1/2"	Self-Shielding Core Type

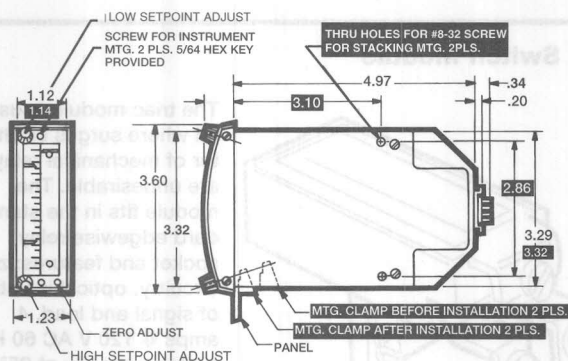
Simpson's Model 3623XO Edgewise Controllers offer an attractive and accurate analog display in a minimum of panel space. The controller provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility and unsurpassed stability. Mounting clips are attached to the controller housing and then tightened against panel without using screws for simplified panel mounting. A unique Simpson self-shielding core magnet provides ± 2 percent standard accuracy or optional $\pm 1\%$ accuracy for either horizontal or vertical scale

orientations. Each unit can be stacked or mounted individually. These controllers feature single and double setpoints with mode indication lamps. DPDT relay or triacs (sold separately) are available for each setpoint. The single high setpoint provides 0-100% adjustability while the dual setpoint units offer 0-98% for low and 2-100% high. All models can be set within 2° of each other for accurate measuring capability. Each knob is removable to prevent tampering. Control switching is within 1.0% F.S. of setpoints and dead band is less than 0.5% of full scale.

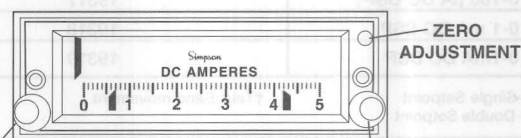
Dimensions and Compatibility

3-1/2"- Model 3623XO

1 = Panel Meter Cut-out Dimensions



Calibration and Adjustments



LOW SETPOINT ADJUSTMENT HIGH SETPOINT ADJUSTMENT (SINGLE)

Setpoint Adjustment

Low and High Setpoint- To adjust setpoint for low range, turn adjustment knob located on lower left portion of front panel. High range adjustment is made by turning the adjustment knob on lower right hand portion of front panel.

Zero Adjustment

For zero adjustment, simply remove the knob used for setpoint adjustment and place in slot on the upper right portion of the front panel.

Mode Indication Lamps

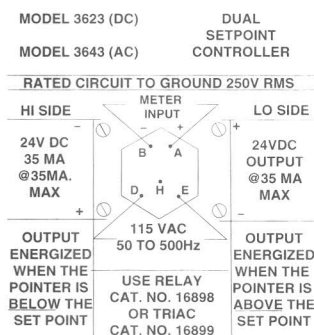
For control applications, when the measurement falls below the lower setpoint or above the high setpoint the corresponding alarm output is activated and the red mode indication lamp lights up. The light on the left side of the dial face represents the low setpoint, while the one on the right represents the high.

Specifications

Accuracy:	±2% F.S. (±1% special order)
Switching Accuracy:	Within 1% F.S. of setpoint indication
Movement:	Self-shielding core type
Suspension:	Pivot and Jewel or Taut Band
Maximum Sensitivity:	10 DC microamps
Single Setpoint:	High limit standard, adjustable 0-100% F.S.
Double Setpoint:	Low 0-98% of F.S. high limit 2-100% of F.S. Setpoints are adjustable within 2°
Output:	24V DC @35mA Max
Repeatability:	2%: Pivot & Jewel; 0.5% Taut Band
Case:	Steel top and bottom with polycarbonate frame and front cover.

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement.
Pointer:	Knife edge with red matte finish
Dead Band:	"On," "Off" differential less than .5% of F.S.
Input Power:	115 VAC single phase, 50-500Hz. 6VA (double setpoint), 4VA (single setpoint).
Storage Temperature:	-40°F to 140°F (-40°C to +60°C)
Operating Temperature.:	+41°F to 122°F (-5°C to +50°C+)
Scale Length:	2.6" (66mm)
Weight:	10 ozs. (0.28g)
Tracking:	±3%

Connections



Input Signal: Input to be monitored is connected to pins A(+) and B(-).

Supply Power: The power source (115 VAC, 50 to 500Hz) for meter operation is connected to pins D and E.

Output: The model 3623 supplies a 24VDC@35mA switching current for each relay (cat. #16898) or triac switch module (cat #16899). Connect the output to the (+) and (-) terminals on the back of the controller as outlined on the diagram.

Ordering Information

Range	Model/Size and Catalog Number
	3-1/2" Model 3623XO
0-50 μ A DC SSP†	19314
0-50 μ A DC DSP†	19315
0-100 μ A DC SSP†	19316
0-100 μ A DC DSP†	19317
0-1 mA DC SSP	19318
0-1mA DC DSP	19319

SSP-Single Setpoint
DSP-Double Setpoint

†Taut-Band movement

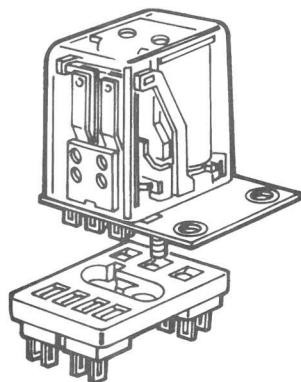
Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	31-32
AC Voltage	C	63-64
DC Voltage	C	123-124

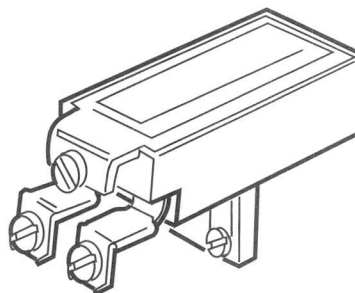
Accessories

Relay Assembly Kit



This Relay Assembly Kit gives the Edgewise Controller the capability to switch a 5 amp load for a setpoint setting. The kit contains one DPDT Relay and Socket Type connector, rated at 5 Amperes resistive load at 120 VAC for each relay pole. The relay can be wired for automatic or manual reset operation. Relay is factory wired for automatic reset operation. The mechanical life of the relay is 1,000,000 operations at rated load.

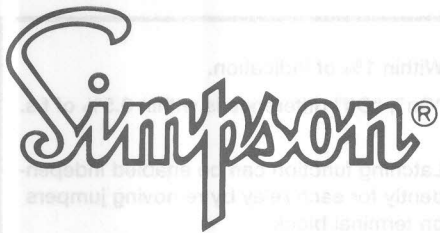
Triac Switch Module



The triac module is useful where surges or chatter of mechanical relays are undesirable. The module fits in the standard edgewise relay socket and features: zero circuitry, optical isolation of signal and load, 4 amps @ 120 V AC 60 Hz, switch capacity at 25° C, and normally open single pole-single throw.

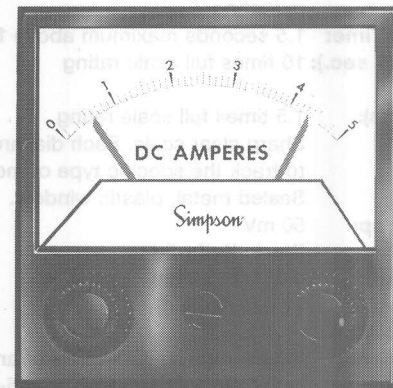
Ordering Information

Description	Catalog Number
Relay Assembly Kit	16898
Triac Switch Module	16899



DC Current Meters

Rugged Seal Controller



- **Wide Variety of Control, Alarm and Limit Use**
- **Three Sizes: 3-1/2", 4-1/2", 4x6"**
- **Calibration not Affected by Steel Panel Mounting**
- **Commercially Sealed Moisture and Dust Proof**
- **Rugged Metal Case**
- **Amplifier Input**

The 33 Series controllers offer a wide variety of applications in control, alarm and limit use. Photo conductor sensing eliminates all interference with the indicating meter. These relays incorporate an amplifier input which drives a rugged high torque pivot and jewel or taut-band meter. Metal cased "Rugged Seal" construction withstands rigorous environmental conditions. The diecast metal case with a drawn steel rear case (plated) gives complete magnetic isolation for steel panel mounting. In addition, each controller is moisture, dust, and dirt proof and recommended for use in wash down areas. Fail safe circuitry opens output relays in the event of power failure. Three different sizes of 3-1/2", 4-1/2", and 4x6" are available in both single and dual setpoint models. High-gain transistor switch circuit provides

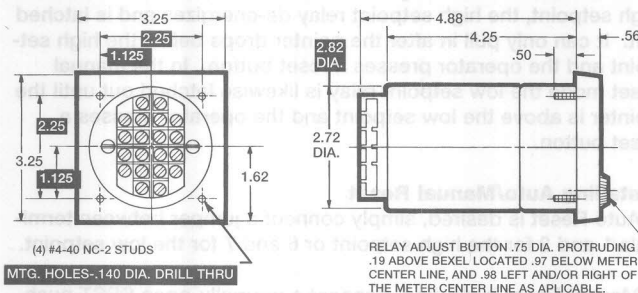
accurate switching with a "dead band" of no more than 0.5% of full scale. All DC current meters offer $\pm 2\%$ of full scale accuracy. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

Model Number	Size	Meter Movement
3323AIXA	3-1/2"	Annular/Self-Shielding
3324AIXA	4-1/2"	Annular/Self-Shielding
3326AIXA	4x6"	Annular/Self-Shielding

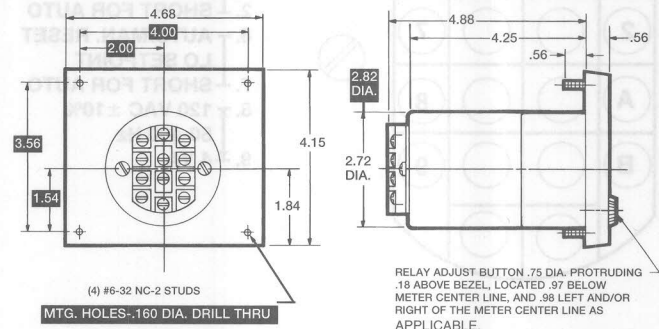
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

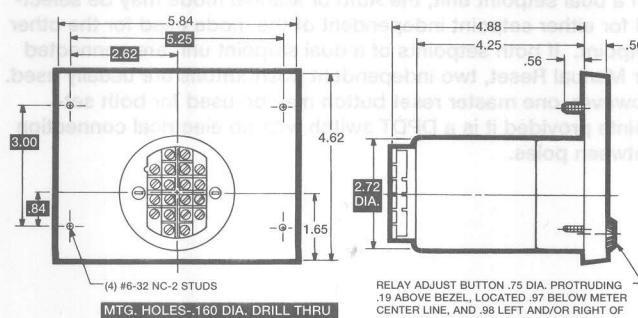
3-1/2"-Model 3323AIXA



4-1/2"-Model 3324AIXA



4x6"-Model 3326AIXA



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec		
YS Series	YS3	YS4
YD Series	YD3	YD4

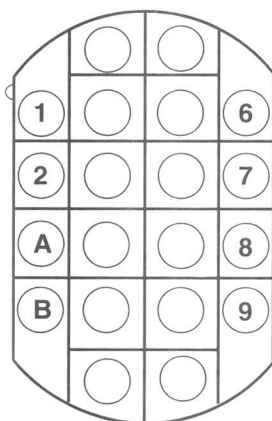
Specifications

Accuracy:	±3% of full scale.
Movement:	Annular-Rectifier, Self-Shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Repeatability:	Within 0.5% F.S.
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum above 10mA
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	Sealed metal, plastic window.
Voltage Drop:	50 mV
Pointer:	Black, Knife-Edge
Scale Length:	4.05" (103.0mm)
Net Weight:	17 ozs (0.48kg)
Control Point(s)	
Adjustments:	Single, high limit, 0-100% of arc; double, low limit 0-95% of arc; high limit 5-100% of arc. Adjustable to within 4° of each other.

Switching:	Within 1% of indication.
Differential:	"On", "Off" difference is within 0.5% of f.s.
Auto/Manual Reset:	Latching function can be enabled independently for each relay by removing jumpers on terminal block.
Contacts/Output Relay:	DPDT relay contacts for each control point Each set of contacts rated at 5 amps, 120/240 VAC resistive.
Frequency Response:	50-1000 Hz.
Power:	108-132 VAC, 50-400 Hz.
Operating Temperature:	+41°F to +122°F (+5°C to +50°C)
Circuit-to-Ground Voltage:	250V rms maximum.
NOTE:	Meters meet ANSI specification C-39.1

Wiring Diagram

REAR VIEW OF HEADER



GND



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
- B. - SIGNAL INPUT
- 1. AUTO/MAN. RESET HI SETPOINT
- 2. SHORT FOR AUTO
- 6. AUTO/MAN. RESET LO SETPOINT
- 7. SHORT FOR AUTO
- 8. 120 VAC ±10%
50-400 Hz
- 9. 4 VA

Input Signal: Input to be monitored is connected to terminals A(+) and B (-). The signal input accepts 5 amperes AC full scale.

Input Power: The power source used is 120VAC ±10%, 50 to 400 Hz. The power requirement is nominally 5VA. Connect power source to terminals 8 and 9.

Auto/Manual Reset

There are two modes of relay logic available in the 33 Series: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is de-energized when the pointer exceeds the high setpoint, and is automatically energized when the pointer again drops below the setpoint. The low setpoint relay is de-energized when the pointer drops below the low setpoint, and is automatically energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay de-energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other setpoint. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent pushbuttons are usually used. However, one master reset button may be used for both setpoints provided it is a DPDT switch with no electrical connection between poles.

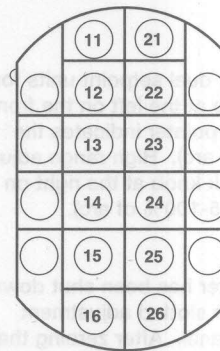
Relays

Relays can be used to “turn on” or “turn off” power to a process that Simpson’s Rugged Seal controller is monitoring. A light can be “turned on” when a setpoint is exceeded, alerting the operator to change a condition in the process. The controller’s relays for both single and dual setpoint meters are double pole, double throw relays.

High Setpoint: The high setpoint relay contacts (both single and dual setpoint meters) are de-energized when the pointer is above the desired setpoint. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts or common. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminals 21 and 24. Terminals 22 and 25 are moving contacts or common. Use terminals 23 and 26 for normally closed relays.

REAR VIEW OF HEADER

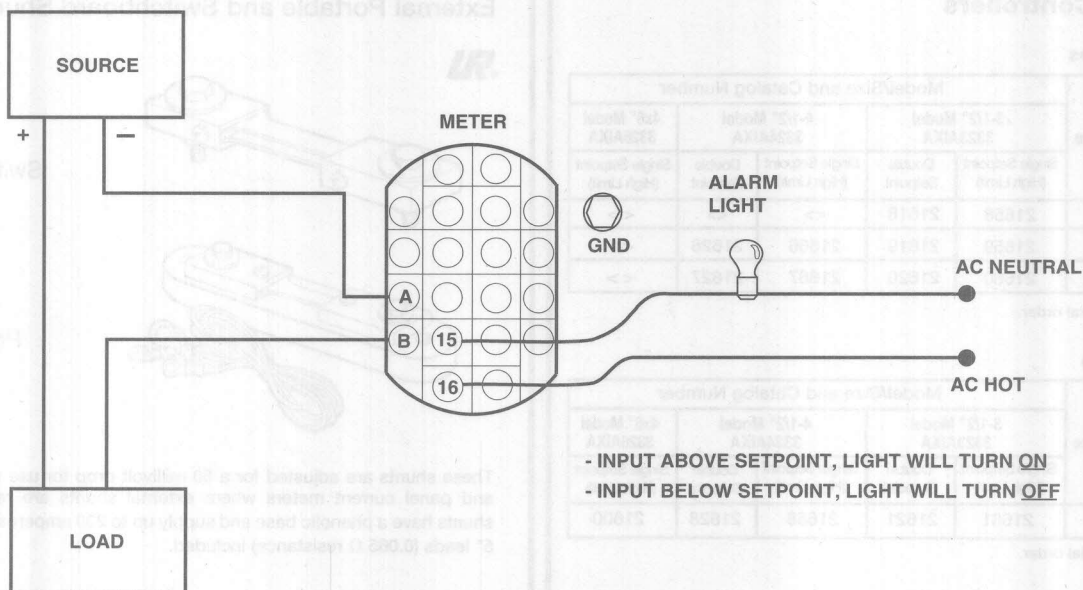


TERMINAL DESIGNATIONS

11. NO	HIGH SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER ABOVE SETPOINT.
12. C	
13. NC	
14. NO	
15. C	LOW SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER BELOW SETPOINT.
16. NC	
21. NO	
22. C	
23. NC	
24. NO	
25. C	
26. NC	

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Application Example



There is a need to control the DC Current being drawn by a load. If the current rises above 3 amperes, there is a problem with the generator, and the operator must be alerted.

A Model 3326AIXA (5 amps) single setpoint relay can monitor the current and switch on a warning light. The meter is installed in series between the source and the load on the negative leg, and the wiring connected to the A(+) and B(-) terminals. Terminal #15 is connected to a warning sign (the negative post) to notify the operator of an overload situation.

The setpoint will be adjusted to 3 amps. If the current goes above the setpoint the relay will de-energize and will “turn on” a light, alerting the operator to a change in condition in the process.

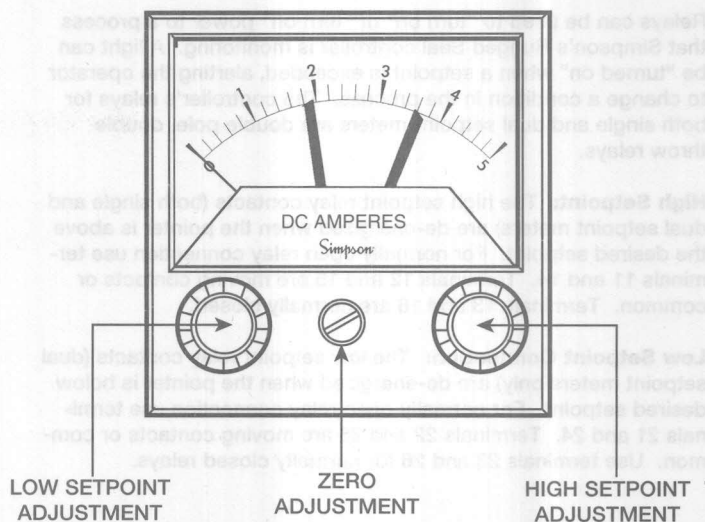
Adjustments

Setpoint Adjustment

Low and High Setpoint — To adjust dual setpoint units for low range, turn the adjustment knob at the left on the front face of the meter until the wide red pointer indicates the desired reading (low from 0-95% of arc). High range adjustments are made by turning the black knob at the right on the front face of the meter (Hi from 5-100% of arc).

Zero Adjustment

Make sure that all power to the meter has been shut down. For zero adjustment, simply turn the slotted adjustment knob which is flush with the front panel. After zeroing the pointer, turn the knob back a few degrees in the direction opposite from your final adjustment. This frees the zero adjust from the pointer mechanism.



Ordering Information

33 Series Controllers

DC Microamperes

Range	Approx. Resistance (ohms)	Model/Size and Catalog Number					
		3-1/2" Model 3323AIXA		4-1/2" Model 3324AIXA		4x6" Model 3326AIXA	
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint
0-25	2 k	21658	21618	<>	<>	<>	<>
0-50	1 k	21659	21619	21666	21626	<>	<>
0-100	500	21660	21620	21667	21627	<>	<>

<> Available on special order.

DC Milliampers

Range	Approx. Resistance (ohms)	Model/Size and Catalog Number					
		3-1/2" Model 3323AIXA		4-1/2" Model 3324AIXA		4x6" Model 3326AIXA	
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint
0-1	50	21661	21621	21668	21628	21600	

<> Available on special order.

DC Amperes

Range	Approx. Resistance (ohms)	Model/Size and Catalog Number					
		3-1/2" Model 3323AIXA		4-1/2" Model 3324AIXA		4x6" Model 3326AIXA	
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint
0-5	.01	21662	21622	21669	21629	<>	<>

<> Available on special order.

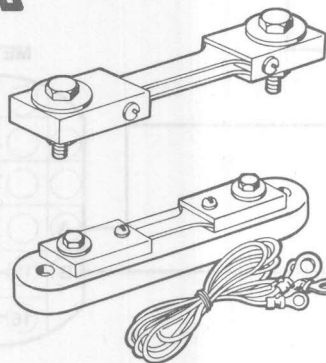
Function Reference Table

For your convenience, the table below lists Rugged Seal Controller models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	33-36
AC Voltage	C	65-68
DC Voltage	C	125-128
Temperature Relays	C	147-150
Motor Load Relays	C	156-157

Accessories

External Portable and Switchboard Shunts



Switchboard

Portable

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and supply up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Portable 50 mV Shunts

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable 100 mV Shunts

Amps	Cat.Number
10	06716
100	06717

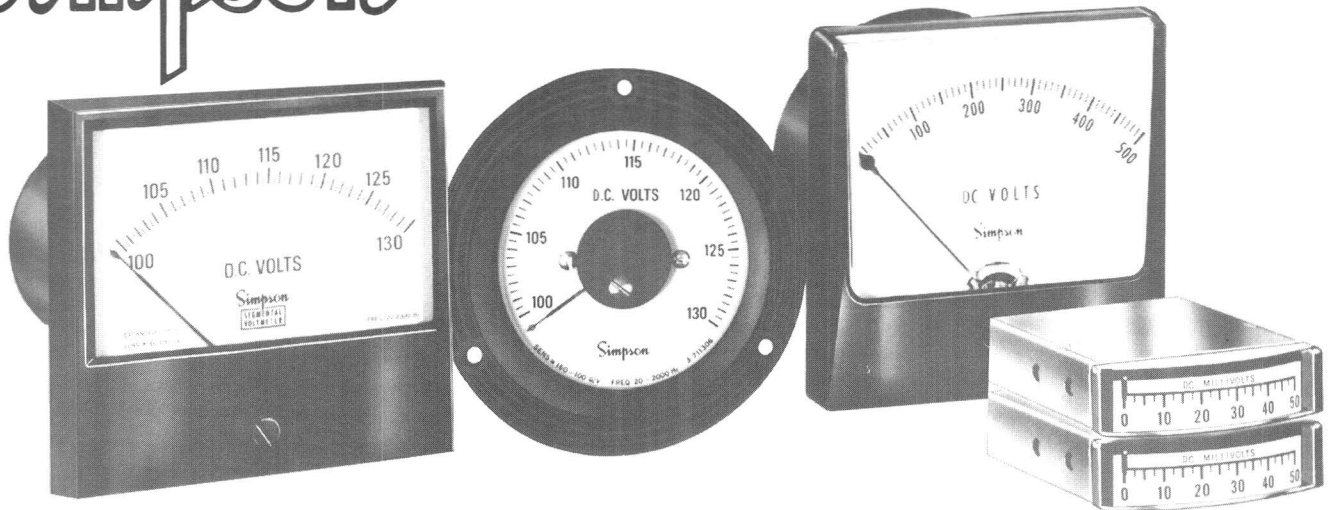
5' leads not included

Switchboard 50 mV Shunts

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

Simpson®

DC Voltage Meters



C
9
9

Simpson DC Voltmeters are available in many standard models and ranges as well as in custom applications. Choose from 1-1/2", 2-1/2", 3-1/2", 4-1/2" and 4x6" sizes. Case styles include Century, Designer, Tru-View, Wide-View, Round and Rectangular, Rugged Seal, Segmental, 250° Long Scale, Edgewise Barrel, Edgewise Stackable and 3-1/2" Edgewise.

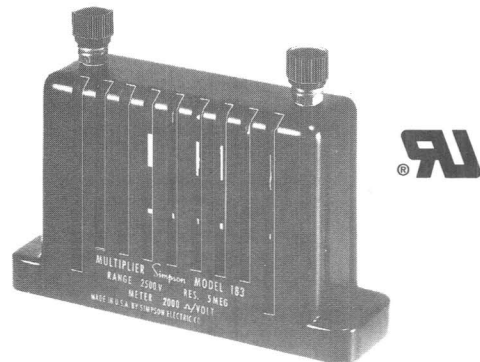
While the Simpson family of DC voltmeters all measure DC voltage, they are not exactly alike and differ in their applications. The 250° Long Scale is designed for applications that require high accuracy readings. 250° panel meters provide more than double the scale length of the standard models. When panel designs require making every square inch count or when weight-saving is important, Edgewise Barrel type or 3-1/2" Edgewise meters solve these design problems. A self-shielding core magnet movement, unique to the Edgewise Stackable panel meter, eliminates the protruding barrel which is prevalent in other Edgewise meters. The Wide-View features modern styling with a durable, open-faced acrylic window for wide-angle readability and protection of the meter face. Round and Rectangular, Designer and Century offer easy reading, attractive design and choice of case styles. Tru-View models feature a modern, clear acrylic front and clean, open scale to update your panel design. Rugged Seal panel meters are ideal where rigorous environments are encountered. They are completely sealed, commercially ruggedized, metal cased and shielded against steel panel mounting. And finally, Segmental meters make it possible to measure very small changes in input conditions. The significant portion of the overall voltage range is expanded to cover the full scale length. Thus, only that segment of the range that is important appears.

Multipliers

Generally, external multipliers are furnished on 1-1/2" 500 volts and higher, 2-1/2" DC meters 750 volts or higher and on 3-1/2" and 4-1/2" DC meters 1000 volts or higher. All others are self contained.

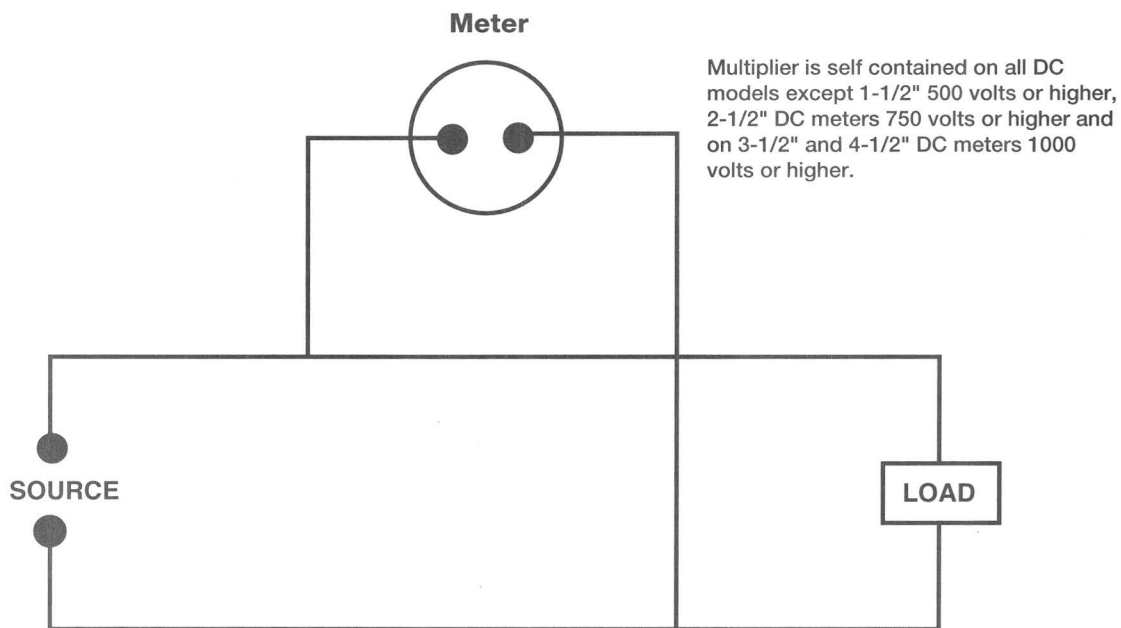
A multiplier is nothing more than a series resistor used within a voltmeter to extend the range.

Model 183 Multiplier Series

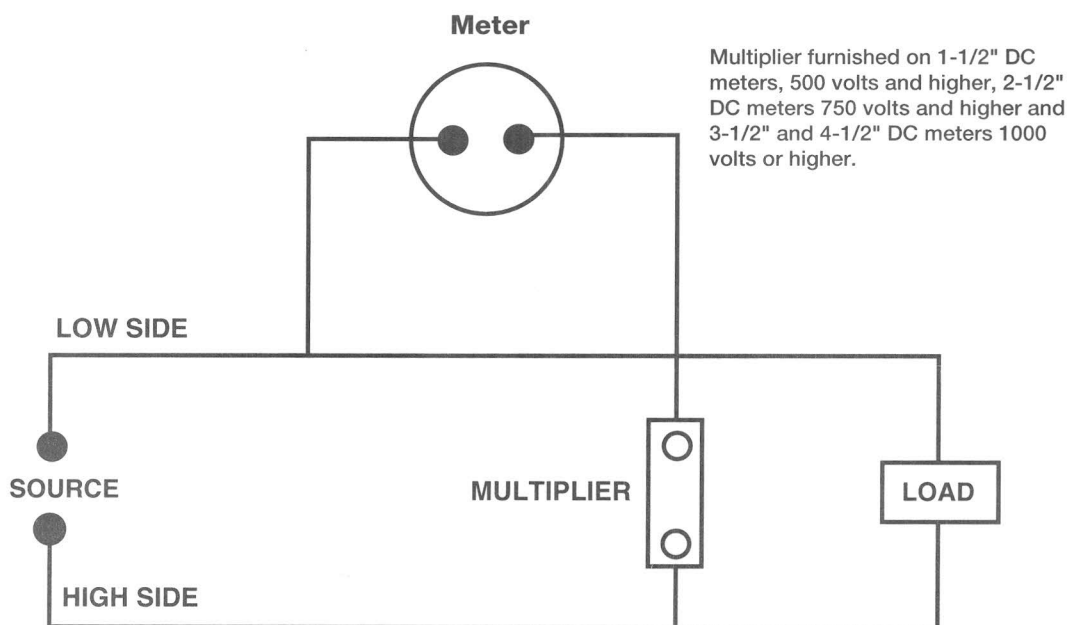


The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

DC Voltage - Self Contained



DC Voltage -With External Multiplier Model 183



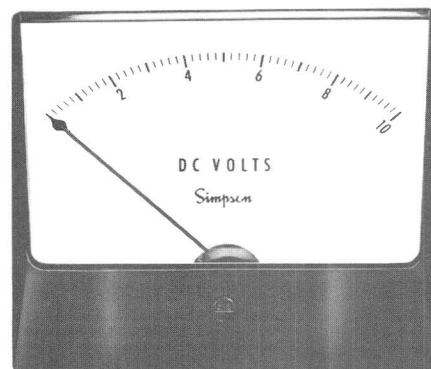


DC Voltage Meters

Wide-Vue Style

- **Wide Angle Visibility**
- **UL Recognized**
- **Phenolic Cases with Clear Acrylic Windows**
- **Distinctive Case Styles**
- **Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", and 4-1/2"**

Molded in a black phenolic case, this distinctive style meter with clear acrylic window provides wide angle visibility and can either be surface mounted or bezel mounted (semi-flush mount) with one of Simpson's Wide-Vue bezel kits. They feature excellent readability and Simpson's "stay accurate" performance. Available in four standard sizes from 1-1/2" to 4-1/2", the Wide-Vue is ideal for reliable measurement of DC voltage ranges between 50 millivolts and 1000 volts. High voltage ranges are furnished with external multipliers. All units are guaranteed to $\pm 2\%$ full scale accuracy and meet American National Standards Institute specification ANSI C39.1. Also available are bezel mount kits for an attractive modern appearance and interchangeability



Mode Number	Size	Meter Movement
1212	1-1/2"	Small Core Magnet
1227	2-1/2"	Annular, Self-Shielding
1327	3-1/2"	Annular, Self-Shielding
1329	4-1/2"	Annular, Self-Shielding

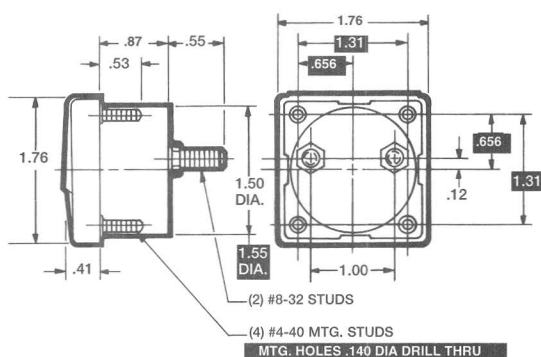
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ty with flush or recess type indicators of other popular styles. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

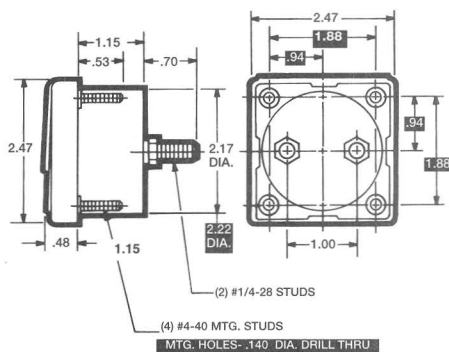
Dimensions

1-1/2"-Model 1212

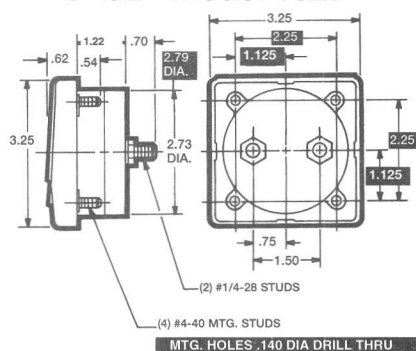
1 = Panel Meter Cut-out Dimensions



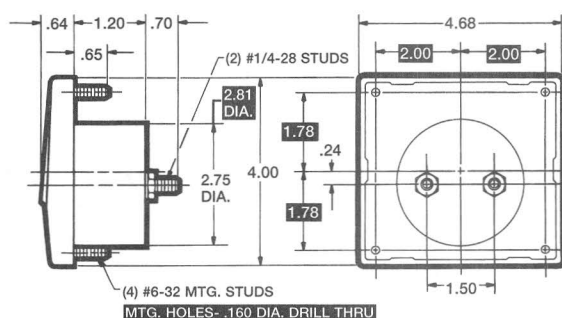
2-1/2"-Model 1227



3-1/2"-Model 1327



4-1/2"-Model 1329



Specifications

Accuracy:	±2% F.S.
Movement:	Models 1227, 1327, 1329: Annular, Self-shielding Model 1212: Small Core Magnet, Self-Shielding
Suspension:	Models 1212, 1227, 1327, 1329: Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Model 1212: Black lance; All other models: Spade with black matte finish.
Scale Length:	Model 1212: 1.50" (38.1mm) Model 1227: 2.3" (58.4mm) Model 1327: 3.14" (79.9mm) Model 1329: 3.93" (100mm)
Net Weight:	Model 1212: 2 oz. (0.06kg) Model 1227: 6 oz. (0.17kg) Model 1327: 8 oz (0.23kg) Model 1329: 9 oz (0.26 kg)

Ordering Information

DC Millivoltmeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212	2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
0-50	10.0	07005	07010	07020	07030
50-0-50	20.0	<>	<>	07021	07031

<> Available on special order.

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 1212	2-1/2" Model 1227	3-1/2" Model 1327	4-1/2" Model 1329
0-5	1000 ohms per volt	09540	09550	09720	09870
0-8		<>	<>	09730	09880
0-10		09541	09560	09740	09890
0-15		09542	09570	09750	09900
0-25		09543	09580	09760	09910
0-30		09544	09590	09770	09920
0-50		09545	09600	09780	09930
0-100		09546	09610	09790	09940
0-150		09547	09620	09800	09950
0-200		<>	09622	09810	09960
0-250	2000 ohms per volt	<>	09623	09820	09970
0-300		<>	09630	09830	09980
0-300		09548	<>	<>	<>
0-500		09549*	09640	09840	09990
0-750		<>	09650*	09850	10000
0-1000		<>	09660*	09860*	10010*

*External multipliers (Model 183) are furnished on 1-1/2" DC meters 500 volts or higher; on 2-1/2" DC meters 750 volts or higher; and on 3-1/2" and 4-1/2" DC meters 1000 volts or higher. All others have self-contained multipliers.

<> Available on special order.

Compatibility Reference Table

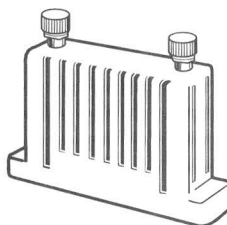
Manufacturer	Size/Model			
	1-1/2"	2-1/2"	3-1/2"	4-1/2"
Beede QAS-	15	25 2-01, 2-04	35 3-01, 14	45 4-01, 4-04
Crompton Celebrity Challenger Clearvu	—	223 362 233	225 363 235	227 364 237
Hoyt	—	3125	3135	3145
Modutec S Series PB Series	—	2S- 2PB*	3S- 3PB*	4S- 4PB
Triplet G Series	—	220-G	320-G	420-G
Weston 2000 Series	—	2021	2031	2041
Yokogawa Big Look Horizon	—	250-2 OPT. 251-210	250-3 OPT. 251-310	250-4 OPT. 1 251-410

*Modutec uses a three-stud mount.

Accessories

Model 183 Multiplier

The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained.



Ordering Information

DC Volts — 2000 Ohms/Volt

Range	Multiplier Resistance Megohms	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561

Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	13-14
AC Voltage	C	39-40
DC Current	C	71-72
Decibels	C	129-130
VU	C	169-170
Watts	C	180-181
DC Galvanometer	C	71-72

Wide-Vue Bezel and Illumination Kits

Behind panel bezels are available for Wide-Vue style meters to give your equipment a modern appearance. Bezel kits are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered with indicators or separately.

Illumination Kits are available for the 4-1/2" indicators. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas.

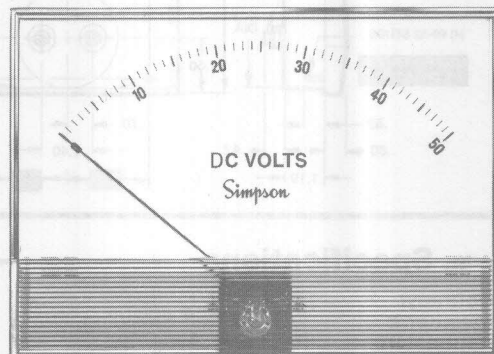
Model Number	Catalog Number
1327 (3-1/2")	01253
1329 (4-1/2")	01123
Illumination Kit 1329	01165



DC Voltage Meters

Tru-Vue Style

- Clear, Acrylic Windows
- $\pm 2\%$ Full Scale Accuracy
- Optional Bezel Kits
- Five Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2", 4x6"
- Special Colored Scales or Logo Available



Simpson's Tru-Vue family of analog panel meters offers a modern, clear acrylic front lens and clean, open scale to update your panel design. Tru-Vue panel meters provide reliable measurement of DC volts from 1 to 1000 volts or 50 to 500 millivolts, and are available in five popular sizes including: 1-1/2", 2-1/2", 3-1/2", 4-1/2", and 4x6" sizes. Higher range inputs require a Model 183 external multiplier (see Accessory Section). All meters are guaranteed to $\pm 2\%$ full scale accuracy and meet American National Standards Institute specification ANSI C39.1. Attractive, black satin, die cast bezels are available in both 3-1/2 and 4-1/2 inch sizes for behind panel mounting. The annular movement with rugged spring-backed pivot-and-jewel suspen-

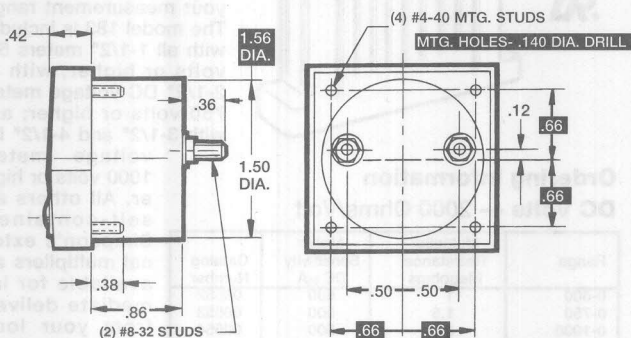
sion is self-shielded from stray magnetic fields. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
921	1-1/2"	Small Core Magnet
922	2-1/2"	Annular, Self-Shielding
923	3-1/2"	Annular, Self-Shielding
924	4-1/2"	Annular, Self-Shielding
926	4x6"	Annular, Self-Shielding

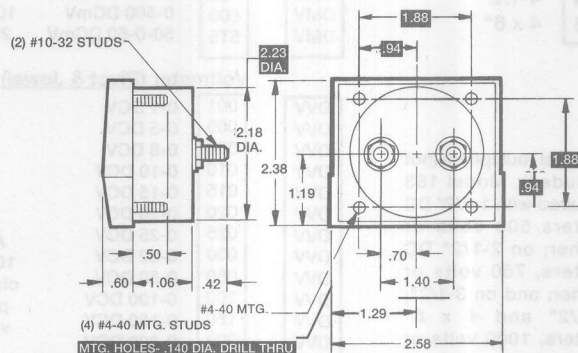
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

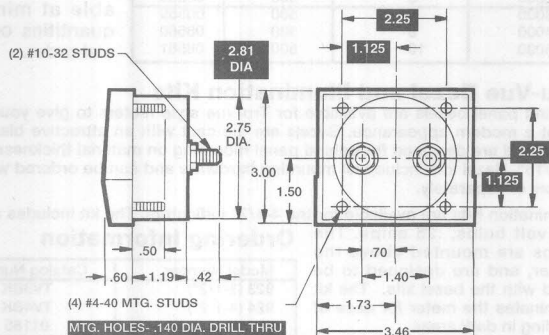
1-1/2" - Model 921



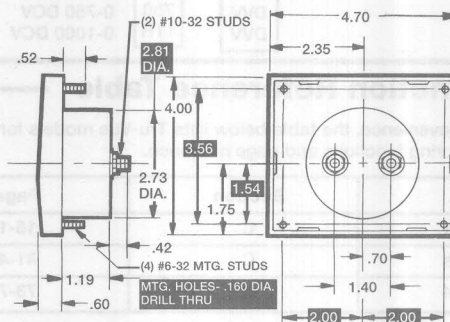
2-1/2" - Model 922



3-1/2" - Model 923



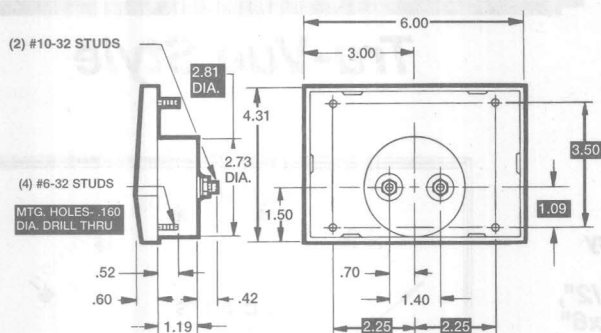
4-1/2" - Model 924



Dimensions and Compatibility

4X6"-Model 926

1 = Panel Meter Cut-out Dimensions



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton	213	215	217
Celebrity	362	363	364
Challenger	223	225	227
Clearvu			
Hoyt			
3100	3125	3125	3145
Custom	2025	2035	2045
Window	3125W	3135W	3145W
Modutec			
S Series	2S-	3S-	4S-
PB Series	2PB*	3PB*	4PB
Triplett			
G Series	220-G	320-G	420-G
Weston			
2000 Series	2021	2031	2041
Yokogawa			
Horizon	251-210	251-310	251-410

*Modutec uses a three-stud mount.

Specifications

Accuracy:	±2% F.S.
Movement:	Annular, Self-Shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Repeatability:	2%
Shielding:	Simpson's self-shielded movement; calibration is unaffected by stray magnetic field or mounting. NOTE: Meters meet ANSI specifications C-39.1
Response Time:	1.5 seconds maximum above 10 mA.
Overload (1 sec.)	10 times full scale rating.
Overload (Continuous):	1.5 times full scale rating
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used

Operating Temperature:	-4 °F to +149 °F (-20 °C to +65 °C)
Resistance:	± 15%
Case:	Model 921: ABS; All Others: Clear acrylic
Pointer:	Black Knife Edge
Scale Length:	Model 921: 1.56" (39.62mm)
	Model 922: 2.40" (60.96mm)
	Model 923: 3.27" (83.06mm)
	Model 924: 3.92" (99.57mm)
	Model 926: 9.45" (138.43mm)
Net Weight:	Model 921: 1.5 oz (0.04 kg)
	Model 922: 4.0 oz (0.11 kg)
	Model 923: 6.0 oz (0.17 kg)
	Model 924: 8.0 oz (0.22 kg)
	Model 926: 12.0 oz (0.34 kg)

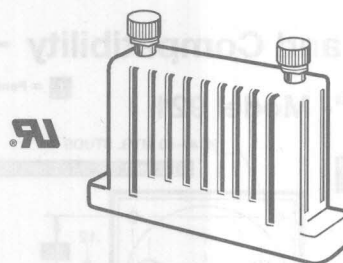
Ordering Information

TV	3	DVV	050
SIZE	FUNCTION	RANGE	≈ ohms
1	1-1/2"		
2	2-1/2"		
3	3-1/2"		
4	4-1/2"		
6	4 x 6"		
	Millivoltmeter (Pivot & Jewel)		
	DMV	050	0-50 DCmV 10.0
	DMV	100	0-100 DCmV 20.0
	DMV	500	0-500 DCmV 100.0
	DMV	5T5	50-0-50 DCmV 20.0
	Voltmeter (Pivot & Jewel)		
	DVV	001	0-1 DCV
	DVV	005	0-5 DCV
	DVV	008	0-8 DCV
	DVV	010	0-10 DCV
	DVV	015	0-15 DCV
	DVV	020	0-20 DCV
	DVV	025	0-25 DCV
	DVV	030	0-30 DCV
	DVV	050	0-50 DCV
	DVV	100	0-100 DCV
	DVV	150	0-150 DCV
	DVV	200	0-200 DCV
	DVV	250	0-250 DCV
	DVV	300	0-300 DCV
	DVV	500	0-500 DCV
	DVV	750	0-750 DCV
	DVV	1TH	0-1000 DCV
			All 1000 ohms per volt

External multipliers (not included), Model 183 required with 1-1/2" DC meters 500 volts or higher; on 2-1/2" DC meters, 750 volts or higher; and on 3-1/2", 4-1/2" and 4 x 6" meters, 1000 volts or higher.

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Ordering Information

DC Volts — 2000 Ohms/Volt

Range	Multiplier Resistance Megohms	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561

Function Reference Table

For your convenience, the table below lists Tru-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	15-16
AC Voltage	C	41-42
DC Current	C	73-74

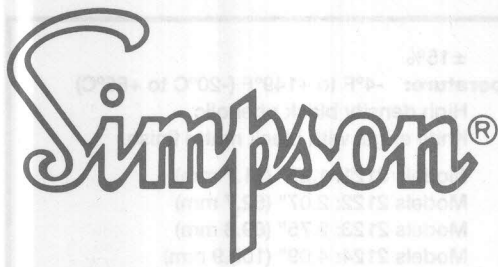
Tru-Vue Bezel and Illumination Kits

Behind panel bezels are available for Tru-Vue style meters to give your equipment a modern appearance. Bezel kits are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered with indicators or separately.

Illumination Kits are available for the 4-1/2" indicators. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas.

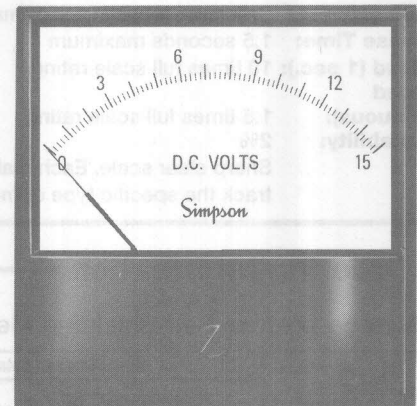
Ordering Information

Model Number	Catalog Number
923 (3-1/2")	TV3BK
924 (4-1/2")	TV4BK
Illumination Kits	01165



DC Voltage Meters

Century Style



Model Number	Size	Meter Movement
2121	1-1/2"	Small Core Magnet
2122	2-1/2"	Annular, Self-shielding
2123	3-1/2"	Annular, Self-shielding
2124	4-1/2"	Annular, Self-shielding

- **UL Recognized**
- **Distinctive Case Style**
- **Phenolic Cases With Glass Windows**
- **Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2"**

An attractive design for industrial or commercial applications, the Century offers maximum reliability and is accurate to ± 2 percent of full scale on all readings. Whether specified for an original design or as a replacement, the Century offers a small core magnet or annular movement that are self-shielded which allows the instrument to be mounted on steel panels. Models are available to measure various voltage ranges up to 1000 Volts DC.

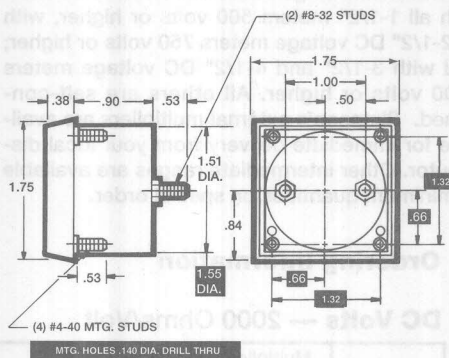
These easy-to-read meters, molded in a black phenolic housing with a large glass viewing window, come in four different sizes from 1-1/2 to 4-1/2 inches. Higher range measurements require an external multiplier mentioned herein. Custom dials can be ordered to fit your specific application. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Compatibility Reference Table

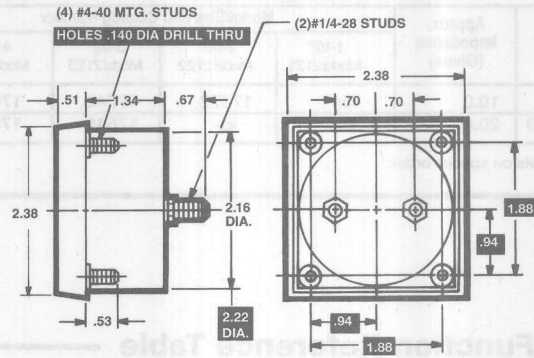
Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Crompton Amerint	233	235	237
Hoyt	4025	4035	4045
Modutec S Series	2S-	3S-	4S-
Triplett G Series	220-GL	320-GL	420-GL
Weston 2000 Series	2021	2031	2041
Yokogawa Horizen	251-220	251-320	251-420

Dimensions

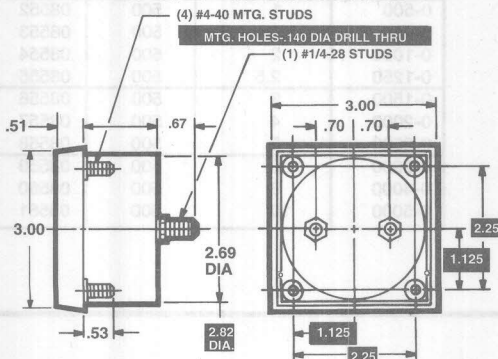
1-1/2"-Model 2121



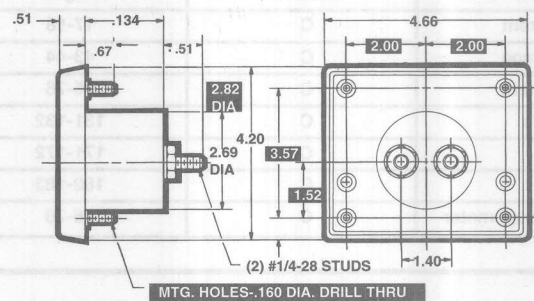
2-1/2"-Model 2122



3-1/2"-Model 2123



4-1/2"-Model 2124



Specifications

Accuracy:	±2% F.S.
Movement:	Model 2121: Small Core Magnet, Self-shielding Models 2122, 2123, 2124: Annular, Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Knife edge, with black matte finish.
Scale Length:	Models 2121: 1.25" (31.7 mm) Models 2122: 2.07" (52.7 mm) Models 2123: 2.75" (69.8 mm) Models 2124: 4.09" (103.9 mm)
Net Weight:	Models 2121: 2 oz. (0.06 kg) Models 2122: 7 oz. (0.20 kg) Models 2123: 8 oz (0.23 kg) Models 2124: 11 oz (0.31 kg)

Ordering Information

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
0-5	1000 ohms per volt	17840	17445	17525	17618
0-8		<>	<>	<>	17619
0-10		17842	17446	17527	17620
0-15		17843	17447	17528	17621
0-25		17844	17448	17529	17622
0-30		17845	17449	17530	17623
0-50		17846	17450	17531	17624
0-100		17848	17451	17532	17625
0-150		17849	17452	17533	17626
0-200		<>	<>	17534	17627
0-250		<>	<>	17535	<>
0-300		<>	17455	17536	17629
0-300		17850	<>	<>	<>
0-500	2000 ohms per volt	17851*	17456	17537	17630
0-750		<>	<>	17538	17631
0-1000		<>	17458*	17539*	17632*

*External multipliers (Model 183) are furnished on 1-1/2" DC meters 500 volts or higher; on 2-1/2" DC meters 750 volts or higher; and on 3-1/2" and 4-1/2" DC meters 1000 volts or higher. All others have self-contained multipliers.
<> Available on special order.

DC Millivoltmeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number			
		1-1/2" Model 2121	2-1/2" Model 2122	3-1/2" Model 2123	4-1/2" Model 2124
0-50	10.0	<>	17472	17540	17636
50-0-50	20.0	<>	<>	17541	17635

<> Available on special order.

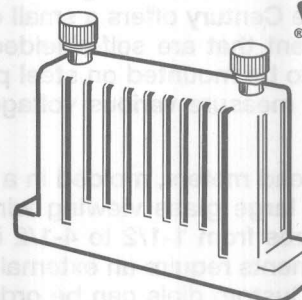
Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	17-18
AC Voltage	C	43-44
DC Current	C	75-76
Decibels	C	131-132
VU	C	171-172
Watts	C	182-183
DC Galvanometer	C	76-76

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Ordering Information

DC Volts — 2000 Ohms/Volt

Range	Multiplier Resistance Megohms	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561

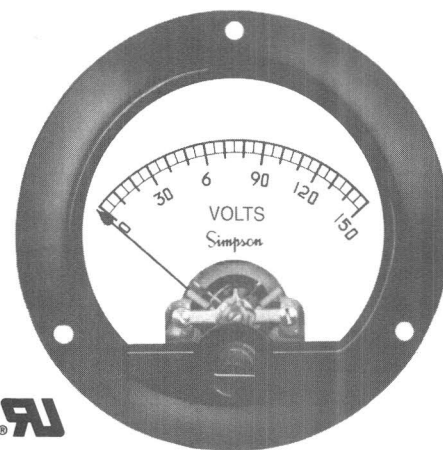


DC Voltage Meters

Round Style

- $\pm 2\%$ Full Scale Accuracy
- UL Recognized
- Phenolic Case with Glass Windows
- Calibration Not Affected By Steel Mounting
- Distinctive Case Style
- Two Popular Sizes: 2-1/2" and 3-1/2"

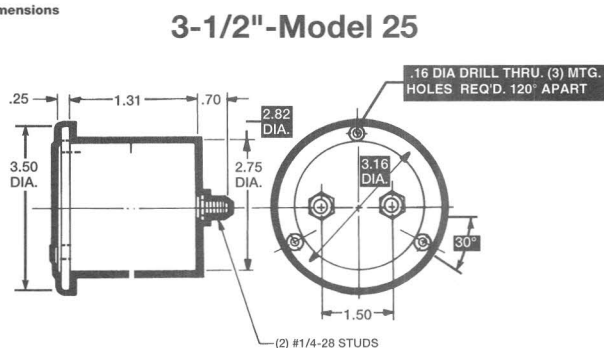
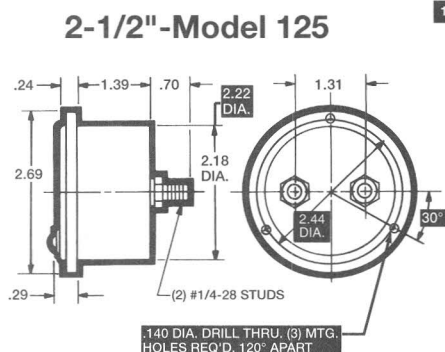
For industrial or commercial applications, the Round style panel meter offers maximum reliability and $\pm 2\%$ full scale accuracy. With a black phenolic case and glass window for optimum viewing, the Round style meter is a popular replacement. All DC units have pivot and jewel suspensions that are spring-loaded for shock protection. The self-shielded meter movement prevents magnetic interaction between the meter and a steel panel. Two popular sizes of 2-1/2" and 3-1/2" are available to measure various voltage ranges up to 5000 volts with multiplier. High voltage ranges are furnished with external multipliers. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.



Model Number	Size	Meter Movement
125	2-1/2"	Annular
25	3-1/2"	Annular

C
1
0
7

Dimensions and Compatibility



Compatibility Reference Table

Manufacturer	Size/Model	
	2-1/2"	3-1/2"
Beede	501	310
Hoyt	17/3	584
Triplett S Series	221-T	—
Weston 200 and 300	201	301

Specifications

Accuracy:	±2% F.S.
Movement:	Annular, self-shielding
Suspension:	Models 25, 125: Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 25: 2.5" (63.5 mm) Model 125: 1.8" (45.7 mm)
Net Weight:	Model 25: 8 ozs (0.23 kg) Model 125: 7 ozs (0.20 kg)

Ordering Information

DC MillivoltMeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		2-1/2" Model 125	3-1/2" Model 25
0-50	10.0†	06970	06910
0-100	20.0	<>	<>

<> Available on special order.

DC Voltage meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number	
		2-1/2" Model 125	3-1/2" Model 25
0-1.5	1000 ohms per volt	08850	<>
0-3		<>	07070
0-5		08870	07080
0-8		<>	<>
0-10		08890	07100
0-15		08900	07110
0-25		08910	07120
0-30		08920	07130
0-50		08930	07140
0-100		08940	07150
0-150		08950	07160
0-200		08960	07170
0-250		08970	07180
0-300		<>	07190
0-500	2000 ohms per volt	<>	07200
0-750		<>	07210
0-1000		<>	07220†
0-1500		<>	<>
0-2000		<>	07240†
0-2500		<>	<>
0-3000		<>	07260†
0-4000		<>	<>
0-5000		<>	07280†

† External multipliers, Model 183, are furnished on 2-1/2" DC meters 750 volts or higher; and on 3-1/2" and 4-1/2" DC meters 1000 volts or higher. All others are self contained.

<> Available on special order.

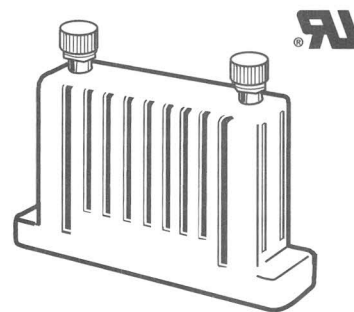
Function Reference Table

For your convenience, the table below lists Round models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	19-20
AC Voltage	C	45-46
DC Current	C	77-78
Decibels	C	133-0134
Watts	C	184-185
DC Galvanometer	C	77-78

Accessories

Model 183 Multiplier



The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Ordering Information

DC Volts — 2000 Ohms/Volt

Range	Multiplier Resistance Megohms	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561

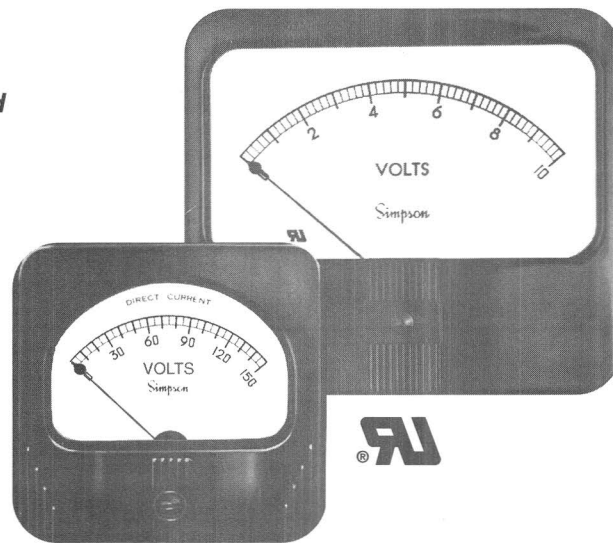


DC Voltage Meters

Rectangular Style

- $\pm 2\%$ Full Scale Accuracy
- UL Recognized
- Phenolic Case with Glass Windows
- Calibration Not Affected By Steel Mounting
- Distinctive Case Style
- Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"

For industrial or commercial applications, the Rectangular style panel meter offers maximum reliability and $\pm 2\%$ full scale accuracy. With a black phenolic case and glass window for optimum viewing, the Rectangular style meter is a popular replacement. All DC units have pivot and jewel suspensions that are spring-loaded for shock protection. The self-shielded meter movement prevents magnetic interaction between the meter and a steel panel. Three popular sizes of 2-1/2", 3-1/2", and 4-1/2" are available to measure various voltage ranges up to 5000 volts. High voltage ranges are furnished with external multipliers. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

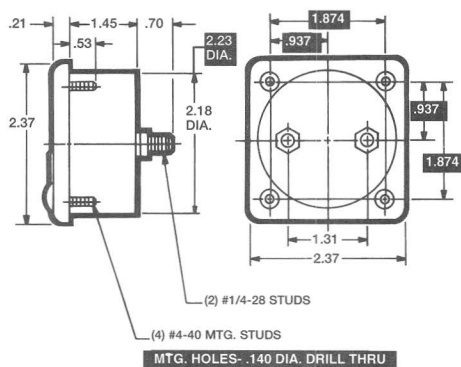


Model Number	Size	Meter Movement
127	2-1/2"	Annular, Self-shielding
27	3-1/2"	Annular, Self-shielding
29	4-1/2"	Annular, Self-shielding

C
109

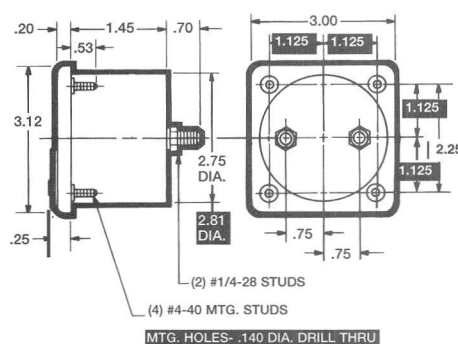
Dimensions and Compatibility

2-1/2"-Model 127

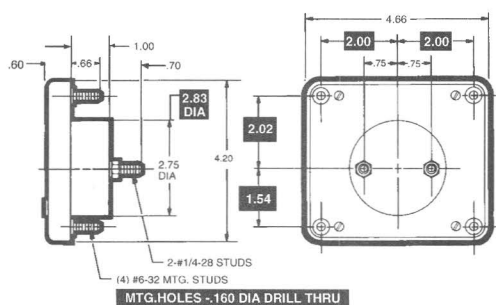


1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 27



4-1/2"-Model 29



Compatibility Reference Table

Manufacturer	Size/Model		
	2-1/2"	3-1/2"	4-1/2"
Beede		15	16/458
Hoyt		597	647/683
Modutec PB Series	2PB*	3PB*	4PB
Triplett S Series	227-T	327-*T	420
Yokogawa Big Look	250-2 OPT.	250-3 OPT.	250-4 OPT. 1

*Modutec Meters use a three-stud mount.

Specifications

Accuracy:	±2% F.S.
Movement:	Annular-Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	SpadePointer, with black matte finish.
Scale Length:	Model 27: 2.5" (63.5 mm) Model 29: 3.9" (99.0 mm) Model 127: 1.8" (45.7 mm)
Net Weight:	Model 27: 8 ozs (0.23Kg) Model 29: 11 ozs (0.31 Kg) Model 127: 7 ozs (0.20 Kg)

Ordering Information

DC Millivoltmeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
0-50	10.0	06990	06930	06950
0-100	20.0	<>	06940	06960

<> Available on special order.

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		2-1/2" Model 127	3-1/2" Model 27	4-1/2" Model 29
0-1.5	1000 ohms per volt	09020	07290	07620
0-3		09030	07300	07630
0-5		09040	07310	07640
0-8		09050	<>	07650
0-10		09060	07330	07660
0-15		09080	07350	07670
0-25		09090	07360	07680
0-30		09100	07370	07690
0-50		09110	07380	07700
0-100		09130	07400	07710
0-150	2000 ohms per volt	09140	07410	07720
0-200		09160	07430	07730
0-250		09170	07440	07740
0-300		09180	07450	07750
0-500		09200	07470	07760
0-750		<>	07490	07770
0-1000		<>	07495†	07780†
0-1500		<>	07520†	07790†
0-2000		09225†	07530†	07800†
0-2500		<>	07550†	07810†
0-3000		<>	07560†	07820†
0-4000		<>	<>	07830†
0-5000		<>	07600†	07840†

† External multipliers, Model 183, are furnished on 2-1/2" DC meters 750 volts or higher; and on 3-1/2" and 4-1/2" DC meters 1000 volts or higher. All others are self contained.
<> Available on special order.

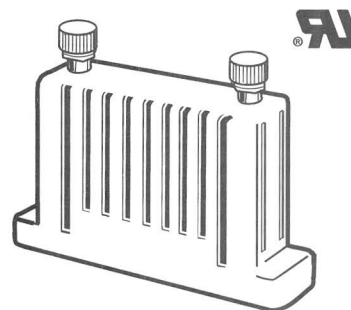
Function Reference Table

For your convenience, the table below lists Rectangular models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	21-22
AC Voltage	C	47-48
DC Current	C	79-80
Decibels	C	135-136
VU	C	173-174
Watts	C	185-186
DC Galvanometer	C	79-80

Accessories

Model 183 Multiplier

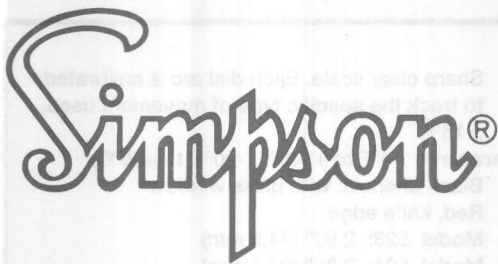


The Model 183 external multiplier enables a voltage meter to monitor up to 5000 DC Volts. An external multiplier is used with a 500 DC μ A instrument that is scaled proportionally to your measurement range. The model 183 is included with all 1-1/2" meters 500 volts or higher, with all 2-1/2" DC voltage meters 750 volts or higher; and with 3-1/2" and 4-1/2" DC voltage meters 1000 volts or higher. All others are self-contained. Simpson's external multipliers are available for immediate delivery from your local distributor. Other intermediate ranges are available at minimum quantities on special order.

Ordering Information

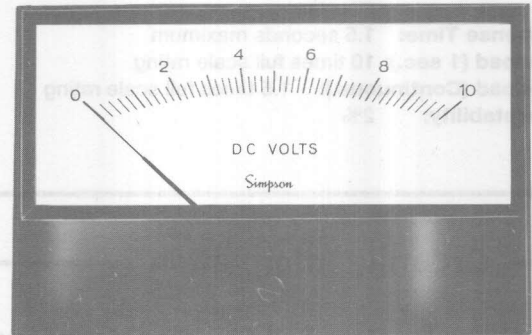
DC Volts — 2000 Ohms/Volt

Range	Multiplier Resistance Megohms	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561



DC Voltage Meters

Designer Style



- **Clean, Uncluttered Look**
- **Phenolic Cases with Glass Windows**
- **Maximum Readability in Minimum Required Height**
- **Two Popular Sizes: 3-1/2", 4-1/2"**
- **Calibration Not Affected by Steel Panel Mounting**

Look to the Designer Series to be used in today's compact equipment designs — without sacrificing readability. The professional styling Designer meters offered by Simpson take up less than 3 inches of panel height for maximum readability in a minimum required height.

With a black phenolic case and glass window for optimum viewing, the Designer has a red knife-edge pointer, providing excellent reliability and ± 2 percent of full

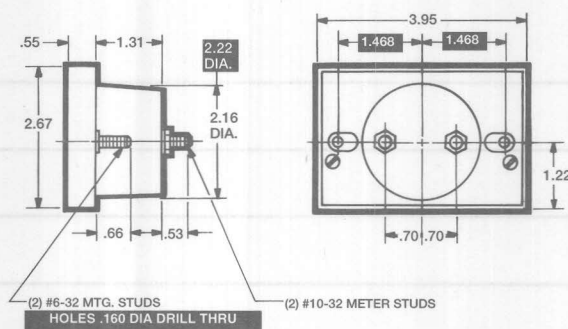
scale accuracy. The 3-1/2 inch and 4-1/2 inch sizes available feature a self-shielding meter movement. This movement construction allows meter to be mounted on steel panels. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
523	3-1/2"	Annular, Self-shielding
524	4-1/2"	Annular, Self-shielding

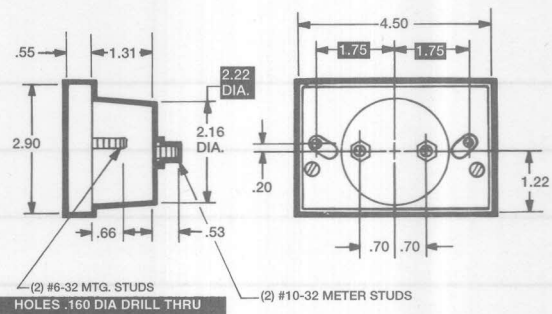
Dimensions and Compatibility

3 1/2"-Model 523

1 = Panel Meter Cut-out Dimensions



4 1/2"-Model 524



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Hoyt	2135	2145
Triplett R Series	320-R	420-R

Specification

Accuracy: $\pm 2\%$ F.S.
Movement: Annular, Self-shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Black phenolic with glass window
Pointer: Red, knife edge
Scale Length: Model 523: 2.92" (74.2 mm)
Model 524: 3.25" (82.5 mm)
Net Weight: Model 523: 9 ozs (0.26 kg)
Model 524: 10 ozs (0.28 kg)

Ordering Information

DC Millivoltmeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number	
		3-1/2" Model 523	4-1/2" Model 524
0-50	10.0	15048	15118

DC Voltage Meters Self-Shielding Meter Movement

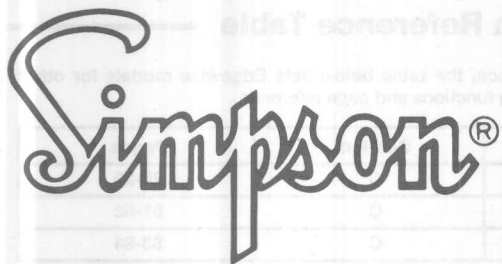
Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number	
		3-1/2" Model 523	4-1/2" Model 524
0-5	1000 ohms per volt	15038	15108
0-10		15039	15109
0-15		15040	15110
0-30		15042	15112
0-50		15044	15114
0-100		15045	15111
0-150		15046	15116

Function Reference Table

For your convenience, the table below lists Designer models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	23-24
AC Voltage	C	49-50
DC Current	C	81-82
VU	C	175-176

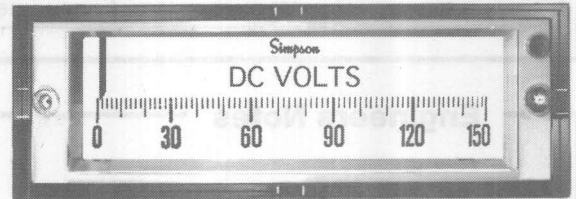
Engineers Notes



DC Voltage Meters

Edgewise 3-1/2" Style

- **Compact and Lightweight**
- **Horizontal Mounting, Vertical on Special Order**
- **Quick, Front of Panel Mounting**
- **Zero Adjust From Front Panel**
- **Accuracy at $\pm 2\%$ of Full Scale ($\pm 1\%$ Available on Special Order)**
- **Self-Shielding Core Magnet Movement**



Model Number	Size	Meter Movement
3623	3-1/2"	Shallow Core Magnet

Simpson's Model 3623 Edgewise panel meter has been designed to satisfy the increasing demand for an attractive and accurate analog display in a minimum of panel space. The Model 3623 provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility, unsurpassed stability and optimum performance.

A unique Simpson self-shielding 1-15/16" shallow core magnet movement provides $\pm 2\%$ full scale standard accuracy or optional $\pm 1\%$ full scale accuracy for either

horizontal or vertical (special order) scale orientations.

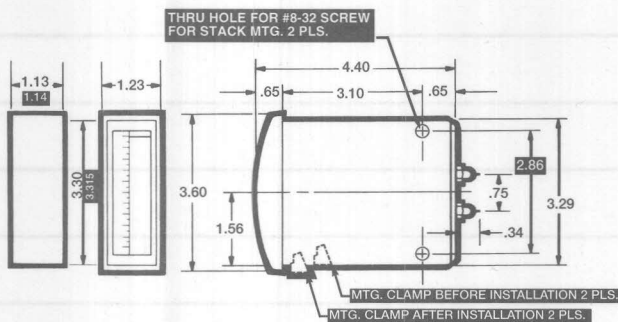
Panel mounting has been simplified to the ultimate. A front bezel Allen screw operates a lock, which slides across a wedge-shaped cam surface, locking the meter in place. When removing, the lock recesses into a slot on the side of the meter. No additional mounting hardware is required.

This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 3623



Compatibility Reference Table

Manufacturer	Size/Model
	31/2"
Triplett E Series	320-EG
Weston 2000 Series	231

Specifications

Accuracy: $\pm 2\%$ F.S. ($\pm 1\%$ special order)
Movement: Shallow Core Magnet, Self-Shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used. Standard dial is white with black printing.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Steel top and bottom with polyester frame and acrylic window.
Pointer: Black, Lance pointer
Scale Length: 2.6" (66 mm)
Net Weight: 9 oz. (0.26 kg)

Ordering Information

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number
0-10	1000 Ohms per Volt	16880
0-15	1000 Ohms per Volt	16881
0-25	1000 Ohms per Volt	16873
0-50	1000 Ohms per Volt	16874

Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	25-26
AC Voltage	C	51-52
DC Current	C	83-84

Engineers Notes

Specifications:		General Features:	
Accuracy:	±2% F.S.	Resistance:	±15%
Movement:	Small Core Magnet, Self-shielding	Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Suspension:	Pivot and Jewel	Case:	Clear acrylic cover with high density phenolic base
Tracking:	±3%	Pointer:	Lance, with red matte finish
Shielding:	Calibration is unaffected by magnetic panel mounting.	Scale Length:	Model 1521: 1.375" (35 mm) Model 1522: 1.875" (47.6 mm)
Response Time:	1.5 seconds maximum	Net Weight:	Model 1521: 2 oz. (0.06 kg) Model 1522: 4 oz. (0.11 kg)
Overload (1 sec.):	10 times full scale rating		
Overload (Continuous):	1.5 times full scale rating		
Repeatability:	2%		
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.		

Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number	
		1-1/2" Model 1521	2-1/2" Model 1522
0-50	10.0	07013	07011

Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number	
		1-1/2" Model 1521	2-1/2" Model 1522
0-10	1000 ohms per volt	10354	10360
0-15		10355	10370
0-25		10356	10375
0-50		10357	10380
0-150		<>	10390
0-500		—	10410

<> Available on special order.

Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
DC Current	C	85-86
AC Voltage	C	53-54
VU	C	177-178

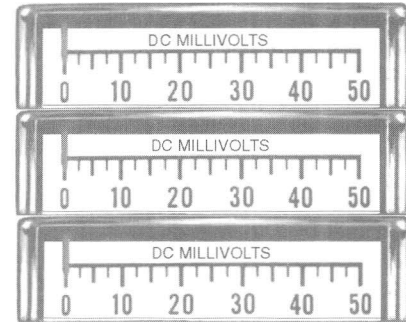
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DC Voltage Meters

Edgewise Stackable

- Compact and Lightweight
- Dustproof Construction
- Steel Housing
- Rustproof Finish
- Two sizes: 1-1/2", 2-1/2"



Simpson's Edgewise stackable panel meters have a unique thin core magnet movement that eliminates the protruding barrel which is prevalent in other edgewise meter designs. It lends itself to a meter that is modern and extremely compact. It is supplied with mounting hardware and bezel. The rugged steel case has a rust-proof finish and a dustproof construction for optimum performance in less than ideal environments. The self-shielded meter movement provides $\pm 2\%$ full scale accuracy. The scale extends nearly to the full width and

Model Number	Size	Meter Movement
1921	1-1/2"	Thin Core Magnet
1622	2-1/2"	Thin Core Magnet

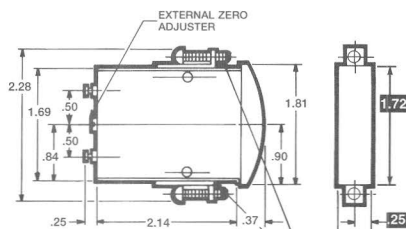
height of the meter. An optimum scale display area permits the use of large easy-to-read numerals on a horizontal plane.

This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions and Compatibility

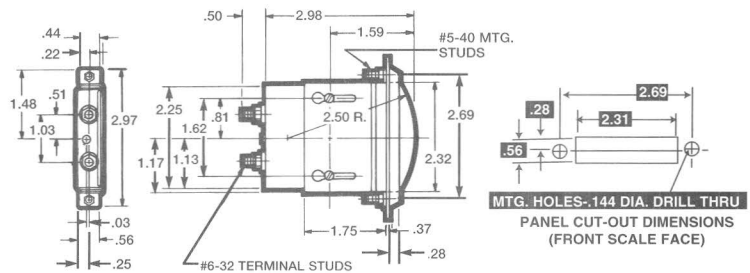
1-1/2"-Model 1921

1 = Panel Meter Cut-out Dimensions



2 REMOVABLE METER BRACKET ASSEMBLIES. BRACKET ASSEMBLIES ARE ADJUSTABLE, SO METERS CAN BE MOUNTED ON PANELS UP TO 9/32" THICK

2-1/2"-Model 1622



Compatibility Reference Table

Manufacturer	Size/Model
	1-1/2"
Crompton	170 Series

C
1
1
8

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	Steel housing with rustproof finish
Pointer:	Red, lance pointer
Scale Length:	Model 1921: 1.37" (35.8 mm) Model 1622: 1.85" (47.0 mm)
Net Weight:	Model 1921: 3 ozs (0.08 kg) Model 1622: 5 oz. (0.14 kg)

Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	55-56
DC Current	C	87-88

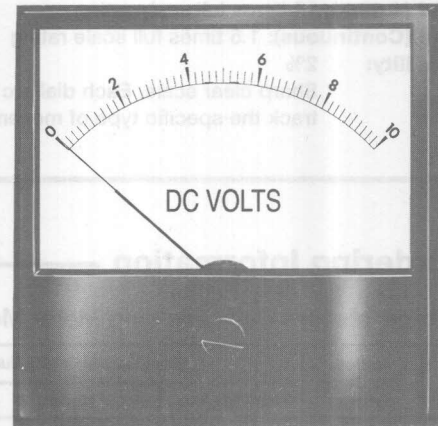
Range	Approx. Impedance (Ohms)	Model/Size & Catalog Number	
		1-1/2" Model 1921	2-1/2" Model 1622
0-10	5000 ohms per volt	18000	18006
0-15		18001	18007
0-25		18002	18008
0-50		18003	18009
0-150		18004	18010

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper appears to be a standard notebook page or a sheet of stationery designed for writing.



DC Voltage Meters

Rugged Seal Style



Model Number	Size	Meter Movement
3323	3-1/2"	Annular
3324	4-1/2"	Annular
3326	4x6"	Annular

- **Rugged Metal Case for Rigorous Environments**
- **Moisture and Dustproof Commercially Sealed**
- **Calibration Not Affected by Steel Panel Mounting**
- **Metal Cased and Shielded**
- **Three sizes: 3-1/2", 4-1/2", 4x6"**
- **O-Ring Sealed Zero Adjust and Electrical Termination**

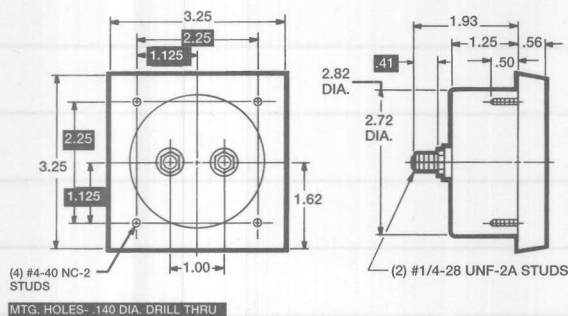
Specifically designed for harsh environments, Simpson's Rugged Seal panel meters are ideal for use in field test equipment or wherever rigorous environmental conditions are encountered. This line of panel meters offers a stylish look with its black metal case and clear glass window. The metal case gives complete magnetic isolation which is especially important in steel panel mounting where stray magnetic fields can induce errors in your reading. In addition, each meter is moisture, dirt, and dustproof. For applications where wash down of control panels is necessary, the Rugged Seal meters are splashproof and offer excellent resistance to water. For added environmental protection, both zero adjust and electrical terminals are O-

ring sealed. The Rugged Seal meters are available in three convenient sizes; 3-1/2", 4-1/2", and 4x6". All DC units have self-shielding meter movements with pivot and jewel suspension and offer $\pm 2\%$ of full scale accuracy. This style meter can be ordered for other functions as specified in the "Function Reference Table"

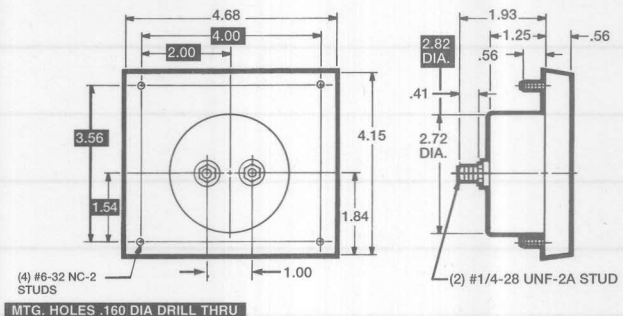
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

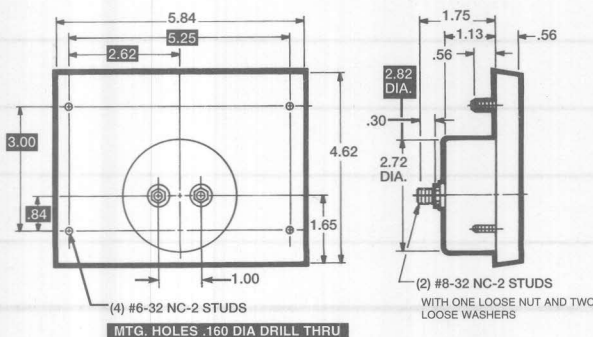
3-1/2"-Model 3323



4-1/2"-Model 3324



4x6"-Model 3326



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec K Series	K3S-	K4S-

Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular, Self-Shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Metal Cover with Black Matte Finish Trim
Pointer: Knife Edge with Black Matte Finish
Scale Length: Model 3323: 2.74 in (70.0 mm)
Model 3324: 4.05 in (103.0 mm)
Model 3326: 4.94 in (125.0 mm)
Net Weight: Model 3323: 12 ozs (0.340 Kg)
Model 3324: 17 ozs (0.48 Kg)
Model 3326: 19 ozs (0.54 Kg)

Ordering Information

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 3323	4-1/2" Model 3324	4x6" Model 3326
0-50	10	16062	16157	16252

DC Voltage Meters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 3323	4-1/2" Model 3324	4x6" Model 3326
0-1.5		16000	$\diamond$	$\diamond$
0-10		16005	$\diamond$	$\diamond$
0-15	1000	16010	$\diamond$	$\diamond$
0-25	ohms	16015	$\diamond$	$\diamond$
0-50	per volt	16020	$\diamond$	$\diamond$
0-100		16025	$\diamond$	$\diamond$
0-500		16030	$\diamond$	$\diamond$

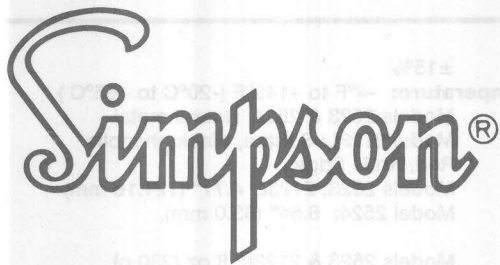
$\diamond$ Available on special order.

Function Reference Table

For your convenience, the table below lists Rugged Seal models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	27-28
AC Voltage	C	57-58
DC Current	C	89-90

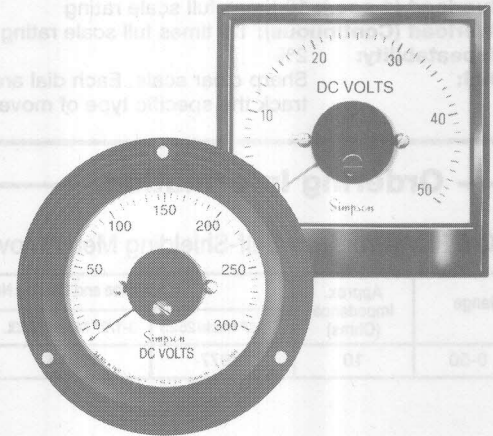
Engineers Notes



DC Voltage Meters

250° Long Scale

- $\pm 2\%$ of Full Scale Accuracy
- Glass Windows
- More Than Double the Scale Length
- Zero Adjust from Front Panel
- Phenolic and Shielded Metal Cases
- Two sizes: 3-1/2", 4-1/2"



Look to the 250° Long Scale analog meters for a full 250° readability that provides more than double the scale length of the standard 90° or 100° movements. Simpson's 250° panel meters are designed for applications that require high-resolution readings all in a compact and attractive design. They are self-shielded, permanent magnet, moving coil meters with nonmagnetic pivots and spring-backed jewels. The movement construction allows meter to be mounted on steel panels. These easy-to-read meters are available in either sealed round metal or in molded square phenolic cases with glass windows. The zero adjust is conveniently

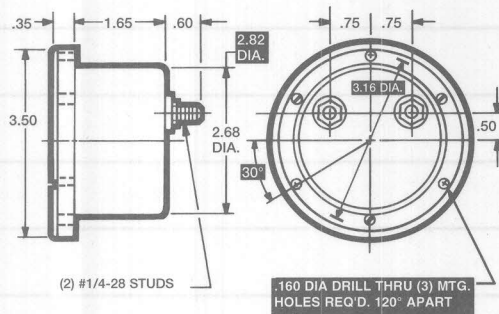
Model Number	Size	Meter Movement
2523	3-1/2"	Self-Shielding
2123L	3-1/2"	Self-Shielding
2524	4-1/2"	Self-Shielding

located on the outer front portion of meter. Two different standard sizes of 3-1/2" and 4-1/2" are available in selected voltage ranges. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

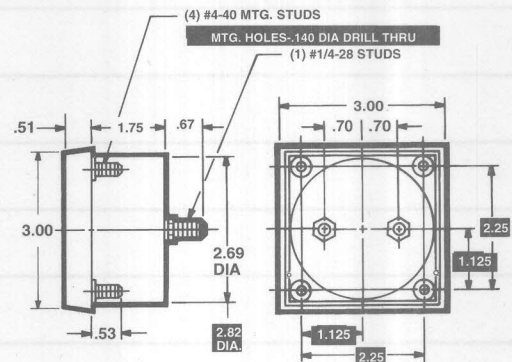
Dimensions and Compatibility

1 = Panel Meter Cut-out Dimensions

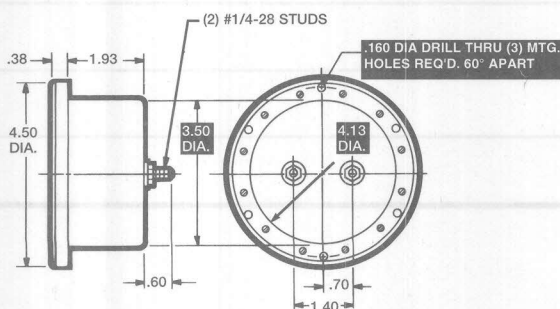
3-1/2"-Model 2523



3-1/2"-Model 2123L



4-1/2"-Model 2524



Manufacturer	Size/Model
	3-1/2"
Beede	3-07-8
Hoyt	250-30

Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Self-shielded, permanent magnet
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: Models 2523 & 2524: Round metal
Model 2123L: Square, black phenolic
Red, Knife Edge.
Pointer:
Scale Length: Models 2523, 2123L: 4.77" (121.16 mm)
Model 2524: 6.54" (63.0 mm)

Net Weight: Models 2523 & 2123L: 8 oz (230 g)
Model 2524: 9 oz (260 g)

Ordering Information

DC Millivoltmeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms)	Model/Size and Catalog Number		
		3-1/2" Model 2523	3-1/2" Model 2123L	4-1/2" Model 2524
0-50	10	17977	17914	17987

Function Reference Table

For your convenience, the table below lists 250° Long Scale models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	29-30
AC Voltage	C	61-62
DC Current	C	91-92

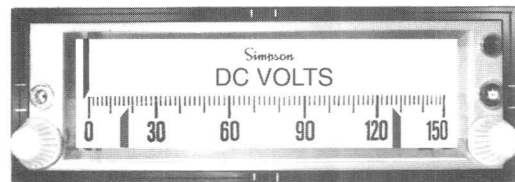
Engineers Notes



DC Voltage Meters

Edgewise Controller

- $\pm 2\%$ Standard Accuracy ($\pm 1\%$ Accuracy Special Order)
- Pivot and Jewel Suspension
- Double or Single Setpoints
- Mode Indication Lamps
- Stacked or Individually Mounted
- Horizontal Mounting (Vertical Mounting On Special Order)
- Control Switching Within 1.0% of Setpoints
- Integral Mounting Lock for Easy Installation
- Removable Set Knobs



Model Number	Size	Meter Movement
3623XO	3-1/2"	Self Shielding Core Type

Simpson's Model 3623XO Edgewise Controllers offer an attractive and accurate analog display in a minimum of panel space. The controller provides a number of user benefits in solving many design panel problems such as front bezel zero adjust with maximum dial visibility and unsurpassed stability. Mounting clips are attached to the controller housing and then tightened against panel without using screws for simplified panel mounting. A unique Simpson self-shielding core magnet provides ± 2 percent standard accuracy or optional $\pm 1\%$ accuracy for either horizontal or vertical scale

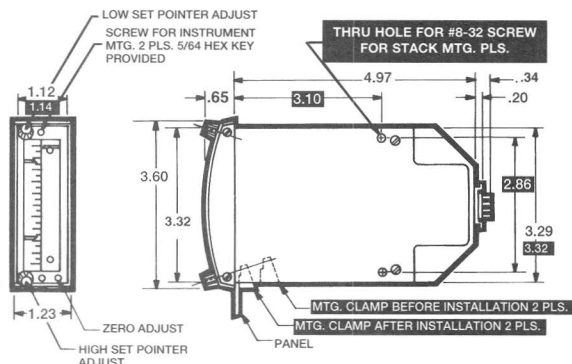
orientations. Each unit can be stacked or mounted individually. These controllers feature single and double setpoints with mode indication lamps. DPDT relay or triac (sold separately) are available for each setpoint. The single setpoint provides 0-100% adjustability while the dual setpoint units offer 0-98% for low and 2-100% high. All models can be set within 2° of each other for accurate measuring capability. Each knob is removable to prevent tampering. Control switching is within 1.0% of setpoints and dead band is less than 0.5% of full scale.

C
1
2
3

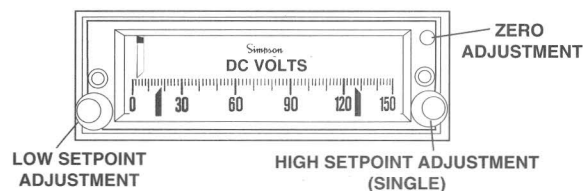
Dimensions and Compatibility

3-1/2" - Model 3623XO

1 = Panel Meter Cut-out Dimensions



Calibration and Adjustments



Setpoint Adjustment

Low and High Setpoint- To adjust setpoint for low range, turn adjustment knob located on lower left portion of front panel. High range adjustment is made by turning the adjustment knob on lower right hand portion of front panel.

Zero Adjustment

For zero adjustment, simply remove the knob used for setpoint adjustment and place in slot on the upper right portion of the front panel.

Mode Indication Lamps

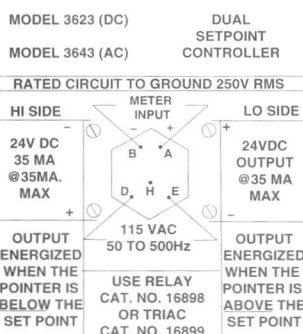
For control applications, when the measurement falls below the lower setpoint or above the high setpoint the corresponding alarm output is activated and the red mode indication lamp lights up. The light on the left side of the dial face represents the low setpoint, while the one on the right represents the high.

Specification

Accuracy:	±2% F.S. (±1% special order)
Switching Accuracy:	Within 1% F.S. of setpoint indication
Movement:	Self-shielding core type
Suspension:	Pivot and Jewel
Maximum Sensitivity:	10 DC microamps
Single Setpoint:	High limit standard, adjustable 0-100% F.S.
Double Setpoint:	Low limit 0-98% of F.S. high limit 2-100% of F.S. Setpoints are adjustable within 2°
Output:	24V DC @35mA Max
Repeatability:	2%

Case:	Steel top and bottom with polyester frame and acrylic window
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Pointer:	Knife edge with red matte finish
Dead Band:	"On," "Off" differential less than .5% of F.S.
Input Power:	115 VAC single phase, 50-500Hz. 6VA (double setpoint), 4VA (single setpoint).
Storage Temperature.:	-40°F to 140°F (40°C to +60°C)
Operating Temperature.:	+41°F to 122°F (+5°C to +50°C)
Scale Length:	2.6" (66mm)
Weight:	10 ozs. (0.28g)
Tracking:	±3%

Connections



Input Signal:	Input to be monitored is connected to pins A(+) and B(-)
Input Power:	The power source (115 Vac, 50 to 500Hz) for meter operation is connected to pins D and E
Output:	The model 3623XO supplies a 24VDC@35mA switching current for each relay (cat. #16898) or triac switch module (cat #16899). Connect the output to the (+) and (-) terminals on the back of the controller as outlined on the diagram

Ordering Information

Range	Model/Size & Catalog Number
	3-1/2" Model 3623XO
0-50 millivolts DC SSP	19320
0-50 millivolts DC DSP	19321

SSP-Single Setpoint
DSP-Double Setpoint

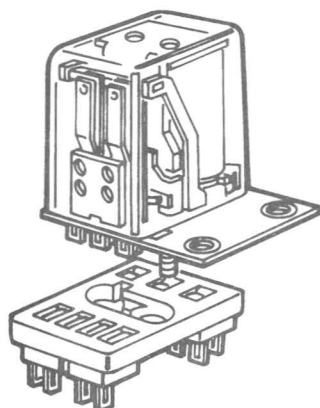
Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	31-32
AC Voltage	C	63-66
DC Current	C	93-94

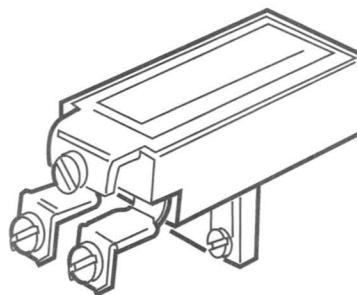
Accessories

Relay Assembly Kit



This Relay Assembly Kit gives the Edgewise Controller the capability to switch a 5 amp load for a setpoint setting. The kit contains one DPDT Relay and Socket Type connector, rated at 5 Amperes resistive load at 120 VAC for each relay pole. The relay can be wired for automatic or manual reset operation. Relay is factory wired for automatic reset operation. The mechanical life of the relay is 1,000,000 operations at rated load.

Triac Switch Module



The triac module is used where surges or chatter of mechanical relays are undesirable. The module fits in the standard edge-wise relay socket and features. Zero circuitry, Optical isolation of signal and load, 4 amps @ 120 V AC 60 Hz, Switch capacity at 25° C, and normally open single pole-single throw.

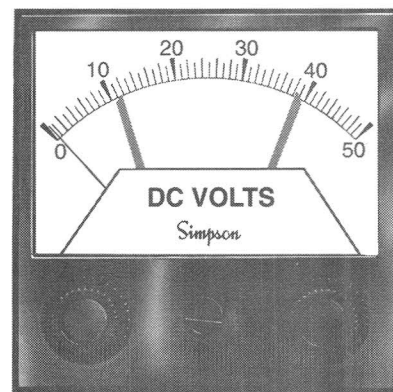
Ordering Information

Description	Catalog Number
Relay Assembly kit	16898
Triac Switch Module	16899



DC Voltage Meters

Rugged Seal Controller



- Wide Variety of Control, Alarm and Limit Use
- Metal Cased and Shielded
- Amplifier Input
- Three sizes: 3-1/2", 4-1/2", 4x6"
- Ruggedized
- Calibration Not Affected by Steel Panel Mounting

The 33 Series controllers offer a wide variety of applications in control, alarm and limit use. Photo conductor sensing eliminates all interference with the indicating meter. These relays incorporate an amplifier input which drives a rugged high torque pivot and jewel or taut-band meter. Metal cased "Rugged Seal" construction withstands rigorous environmental conditions. The dicast metal case with a drawn steel rear case (plated) gives complete magnetic isolation for steel panel mounting. In addition, each controller is moisture, dust, and dirt proof and recommended for use in wash down areas. Fail safe circuitry opens output relays in the event of power failure. Three different sizes of 3-1/2", 4-1/2", and 4x6" are available in both single and dual setpoint models. High-gain transistor switch circuit provides

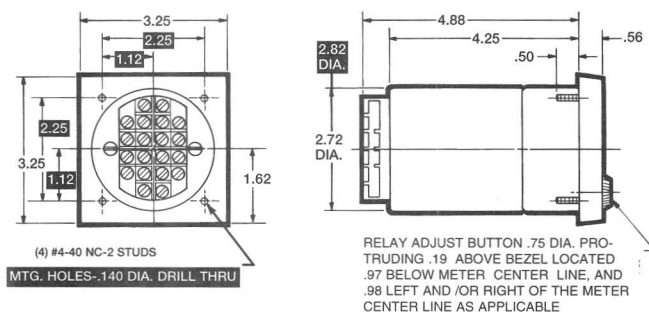
accurate switching with a "dead band" of no more than 0.5% of full scale. Fail safe circuitry opens output relays in the event of power failure. All DC voltage units offer $\pm 2\%$ of full scale accuracy. This style meter is ideal for other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
3323AIXA	3-1/2"	Annular
3324AIXA	4-1/2"	Annular
3326AIXA	4x6"	Annular

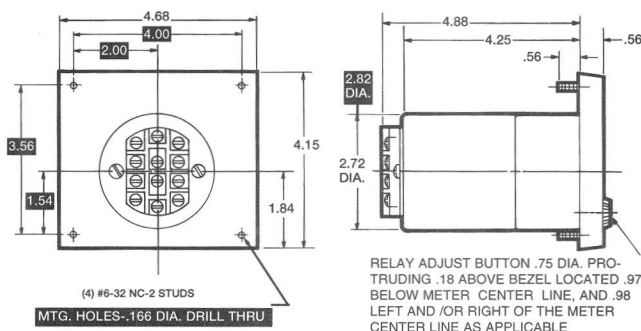
C
1
2
5

Dimensions and Compatibility

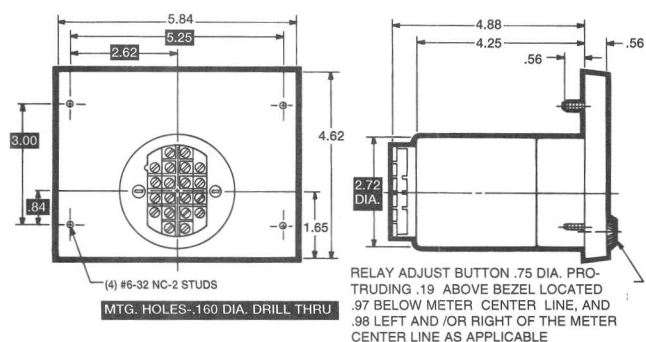
3-1/2"-Model 3323AIXA



4-1/2"-Model 3324AIXA



4x6"-Model 3326AIXA



Compatibility Reference Table

Manufacturer	Size/Model	
	3-1/2"	4-1/2"
Modutec YS Series	YS3	YS4
YD Series	YD3	YD4

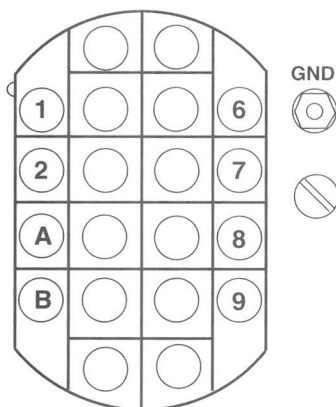
Specifications

Accuracy:	±3% of F.S.
Movement:	Self-shielding, annular
Suspension:	Pivot and Jewel
Adjustments:	Single, 0-100% of arc; double, low limit 0-95% of arc; high limit, 5-100% of arc. Adjustable to within 4° of each other.
Switching:	Within 1% of indication
Differential:	"On", "Off" difference is within 0.5% of F.S.
Auto/Manual Reset:	Latching function can be enabled independently for each relay by removing jumpers on terminal block.
Contacts/Output Relays:	DPDT relay contacts for each control point except motor load types. SPDT low point. Each set of contacts rated at 5 amps, 115 VAC.

Repeatability:	Within 0.5% F.S.
Frequency Response:	50-1000 Hz
Power:	108-132 VAC, 50-400 Hz.
Operating Temperature:	+41°F to +122°F (+5°C to +50°C)
Circuit-to-Ground Voltage:	250 RMS maximum
Case:	Sealed metal, plastic window.
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Tracking:	±3%

Wiring Diagram

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
- B. - SIGNAL INPUT
- 1. AUTO/MAN. RESET HI SETPOINT
- 2. SHORT FOR AUTO
- 6. AUTO/MAN. RESET LO SETPOINT
- 7. SHORT FOR AUTO
- 8. 120 VAC ±10%
50-400 Hz
- 9. 4 VA

Auto/Manual Reset

There are two modes of relay logic available in the 3344AIXA: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is energized when the pointer exceeds the high setpoint, and is automatically de-energized when the pointer again drops below the setpoint. The low setpoint relay is energized when the pointer drops below the low setpoint, and is automatically de-energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram.

Input Signal: Input to be monitored is connected to terminals A(+) and B (-). The signal input accepts 5 amperes AC full scale.

Input Power: The power source used is 120VAC ±10%, 50 to 400 Hz. The power requirement is nominally 5VA. Connect power source to terminals 8 and 9.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other setpoint. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent pushbuttons are usually used. However, one master reset button may be used for both setpoints provided it is a double pole switch with no electrical connection between poles.

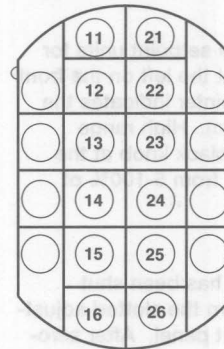
Relays

Relays can be used to "turn on" or "turn off" power to a process that the 3343AIXA and 3344AIXA are monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to change a condition in the process. The controller's relays for both single and dual setpoint meters are double pole, double throw relays.

High Setpoint: The high setpoint relay contacts (on both single and dual setpoint meters) are de-energized when the pointer is above the desired setpoint. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (appear on dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminals 21 and 24. Terminals 22 and 25 are moving contacts or common. Use terminals 23 and 26 for normally closed relays.

REAR VIEW OF HEADER

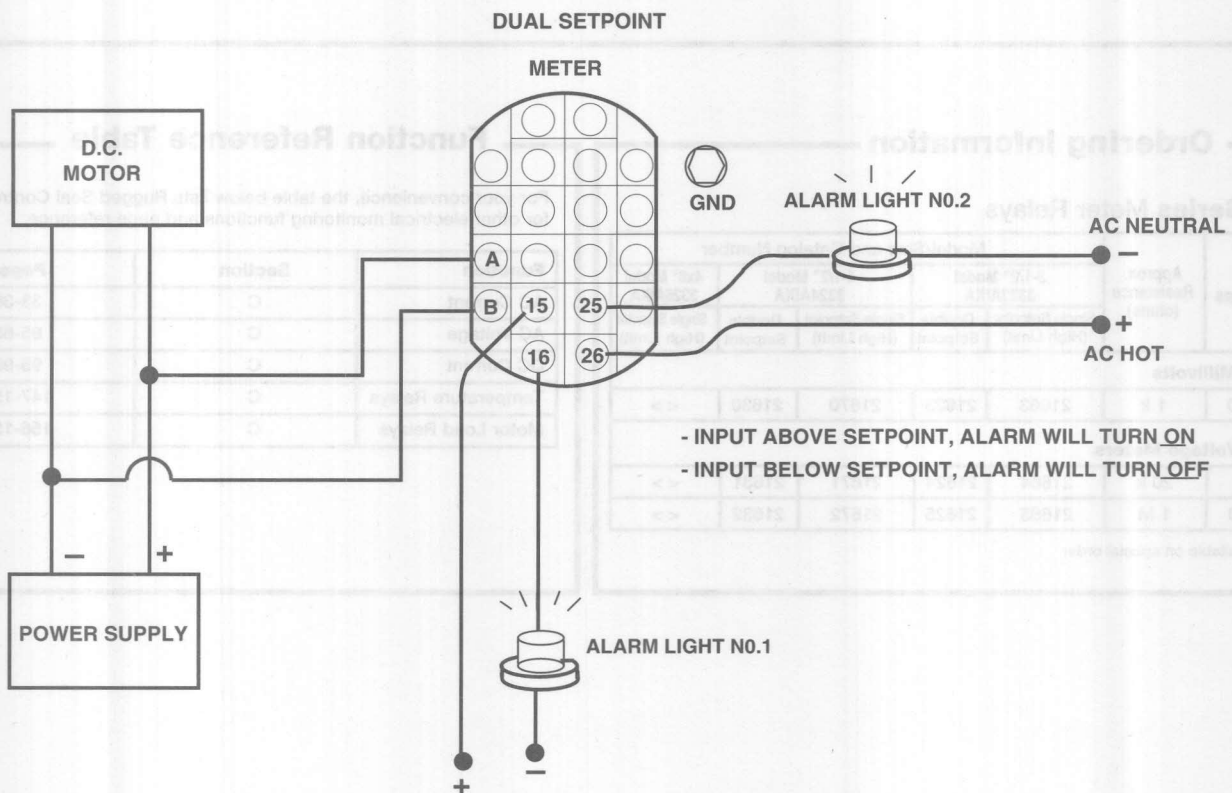


TERMINAL DESIGNATIONS

11. NO	HIGH SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER ABOVE SETPOINT.
12. C	
13. NC	
14. NO	
15. C	LOW SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER BELOW SETPOINT.
16. NC	
21. NO	
22. C	
23. NC	LOW SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER BELOW SETPOINT.
24. NO	
25. C	
26. NC	

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Application Example



There is a need to monitor the power supply voltage of a 30 volt DC motor. The requirements call for a relay to turn on (de-energize) when the pointer is above 30 volts or below 20 volts. A model 3324AIXA is installed in parallel with the power source.

Terminal A is connected to the positive lead of the power supply. Terminal B is connected to the negative lead of the power supply. For the high setpoint, terminals 15 (common) and 16 (normally closed) are used for normally closed relay connection. For the low setpoint, terminals 25 (common) and 26 (normally closed) are used for normally closed relay connection. The normally closed relay de-energizes when the signal input equals or exceeds 30 volts and falls below 20 volts. The de-energized relay will trip an alarm to alert an operator of the change in state.

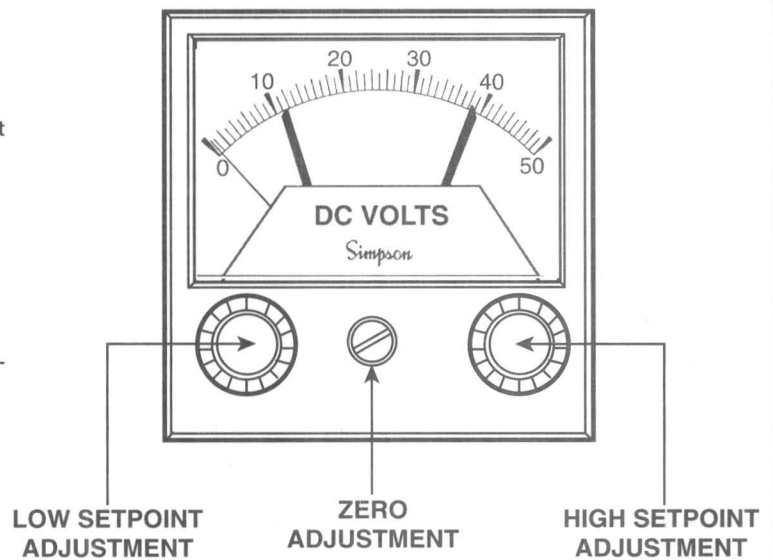
Adjustments

Setpoint Adjustment

Low and High Setpoint- To adjust dual setpoint units for low range, turn the adjustment knob at the left on the front face of the meter until the wide red pointer indicates the desired reading (low from 0-95% of arc). High range adjustments are made by turning the black knob at the right on the front face of the meter (Hi from 5-100% of arc).

Zero Adjustment

Make sure that all power to the meter has been shut down. For zero adjustment, simply turn the slotted adjustment knob which is flush with the front panel. After zeroing the pointer, turn the knob back a few degrees in the direction opposite from your final adjustment. This frees the zero adjust from the pointer mechanism.



C
1
2
8

Ordering Information

33 Series Meter Relays

Ranges	Approx. Resistance (ohms)	Model/Size and Catalog Number					
		3-1/2" Model 3323AIXA		4-1/2" Model 3324AIXA		4x6" Model 3326AIXA	
		Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	Double Setpoint	Single Setpoint (High Limit)	
DC Millivolts							
0-50	1 k	21663	21623	21670	21630	< >	
DC Voltage Meters							
0-1	20 k	21664	21624	21671	21631	< >	
0-50	1 M	21665	21625	21672	21632	< >	

<> Available on special order

Function Reference Table

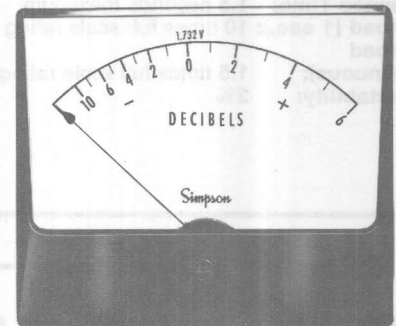
For your convenience, the table below lists Rugged Seal Controller models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	33-36
AC Voltage	C	65-68
DC Current	C	95-98
Temperature Relays	C	147-150
Motor Load Relays	C	156-157



Decibel Meters

Wide-Vue Style



- Zero Power Reference Level of 6 mW into 500 ohms
- Phenolic Cases with Clear Acrylic Windows
- Wide Angle Visibility
- Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2"
- UL Recognized
- Optional Bezel and Illumination Kits

Simpson's decibel (dB) meters cover a scale span from minus 10 to plus 6 dB and are designed for use with a zero power reference level of 6 milliwatts into 500 ohms. With this zero power reference level a sinusoidal potential of 1.732 volts applied to the meter will deflect the pointer to the zero dB spot on the dial. When the sinusoidal potential is applied, the Simpson dB meter will have an internal terminal impedance of 5000 ohms.

In addition to quality dB measurement, each meter is quality constructed with a molded black phenolic case and a clear acrylic window that provides wide angle visibility and thin profile panel mounting. The Wide-Vue



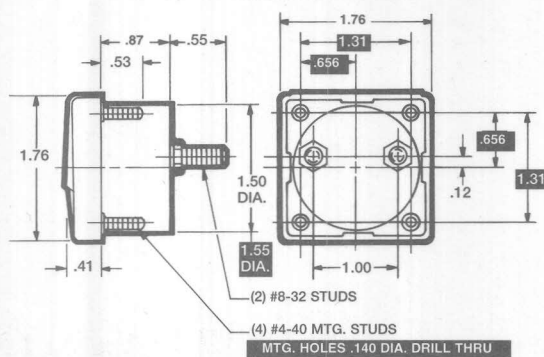
Model Number	Size	Meter Movement
1214	1-1/2"	Small Core Magnet
1247	2-1/2"	Annular-Rectifier
1347	3-1/2"	Annular-Rectifier
1349	4-1/2"	Annular-Rectifier

style dB meter can be surface mounted or bezel mounted (semi-flush mounted) with one of Simpson's Wide-Vue bezel kits. Available in four standard sizes from 1-1/2" (on special order) to 4-1/2", Simpson's dB meters can solve your application requirements. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

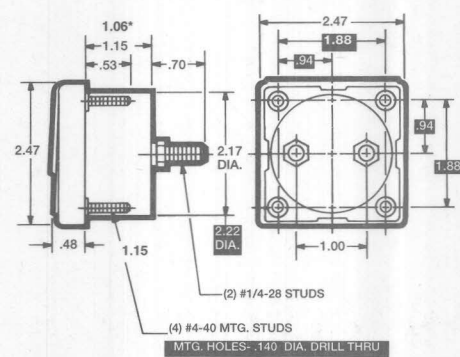
Dimensions

1 = Panel Meter Cut-out Dimensions

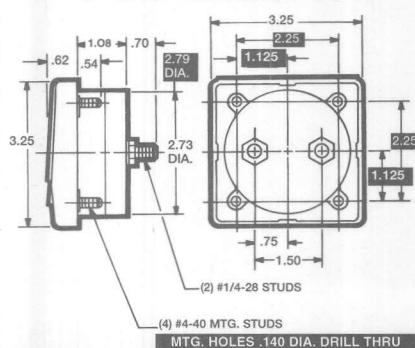
1-1/2"-Model 1214



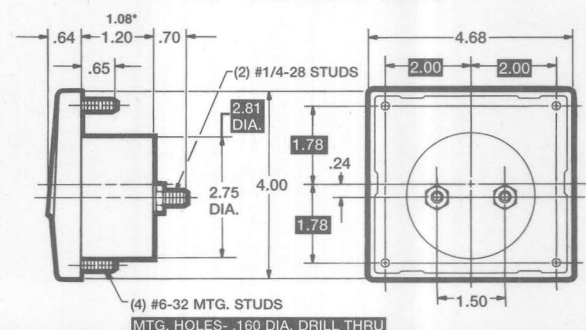
2-1/2"-Models 1247



3-1/2"-Models 1347



4-1/2"-Models 1349



Specifications

Accuracy:	±3% F.S.
Movement:	Model 1214: Small Core Magnet Models 1247, 1347, 1349: Annular-Rectifier Pivot and Jewel
Suspension:	±3%
Tracking:	Calibration is unaffected by magnetic panel mounting
Shielding:	
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload	
(Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Model 1214: Lance, with black matte finish Models 1247, 1347, 1349: Spade, with black matte finish.
Scale Length:	Model 1214: 1.5" (38.1mm) Model 1247: 2.3" (58.4mm) Model 1347: 3.14" (79.9mm) Model 1349: 3.93" (100mm)
Net Weight:	Model 1214: 2 oz (0.06kg) Model 1247: 6 oz (0.17kg) Model 1347: 8 oz (.23kg) Model 1349: 9 oz (.26kg)

Ordering Information

Decibel Meters Zero Power Level: 6 mW into 500 Ohm line. Self Shielding

Range	Approx. Impedance (Ohms) @ 60 Hz	Model/Catalog Number			
		2-1/2" Model 1214	2-1/2" Model 1247	3-1/2" Model 1347	4-1/2" Model 1349
-10 to +6 dB	5000	<>	03483	03485	03487

<> Available on special order.

Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions and page reference.

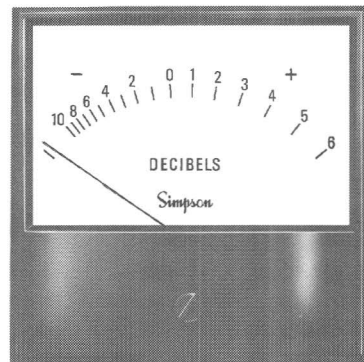
Function	Section	Pages
AC Current	C	13-14
AC Voltage	C	39-40
DC Current	C	71-72
DC Voltage	C	101-102
RF Current	C	159-160
VU	C	169-170
Watts	C	180-181



Decibel Meters

Century Style

- Zero Power Reference Level of 6 mW into 500 ohms
- Phenolic Case with Glass Window
- Scale Span From Minus 10 to Plus 6 dB
- Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"
- $\pm 3\%$ Full Scale Accuracy
- UL Recognized



An attractive design for industrial or commercial applications, the Century offers maximum reliability and is accurate to $\pm 3\%$ F.S. The Century decibel (dB) meters cover a scale span from minus 10 to plus 6 dB and are designed for use with a zero power reference level of 6 milliwatts into 500 ohms. With this zero power reference level a sinusoidal potential of 1.732 volts applied to the meter will deflect the pointer to the zero dB spot on the dial. When the sinusoidal potential is applied, the Simpson dB meter will have an internal terminal impedance of 5000 ohms.

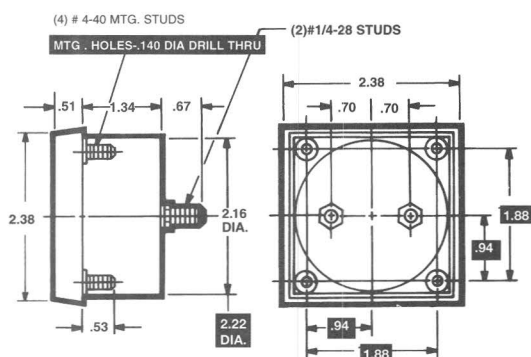
In addition to quality dB measurement, each meter is

Model Number	Size	Meter Movement
2142	2-1/2"	Annular-Rectifier
2143	3-1/2"	Annular-Rectifier
2144	4-1/2"	Annular-Rectifier

quality constructed with a molded black phenolic case, sharp, beveled edges and a clear glass window for easy viewing. Available in three standard sizes of 2-1/2", 3-1/2", and 4-1/2", the Century dB meters can solve your application requirements. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

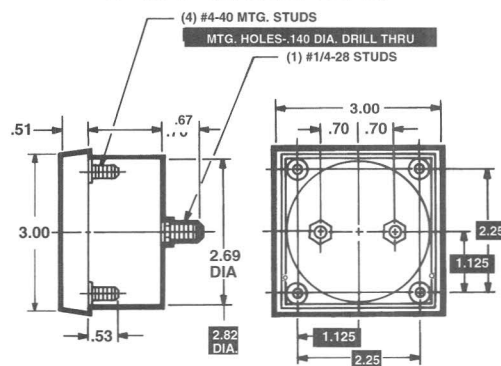
Dimensions

2-1/2"-Model 2142

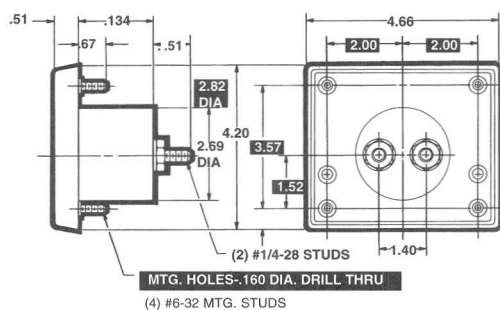


1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 2143



4-1/2"-Model 2144



Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Annular-Rectifier
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Knife edge, with black matte finish.
Scale Length: Model 2142: 2.07" (52.7mm)
 Model 2143: 2.75" (69.8mm)
 Model 2144: 3.71" (94.2mm)
Net Weight: Model 2142: 7 oz (0.20kg)
 Model 2143: 8 oz (.23kg)
 Model 2144: 11 oz (0.31kg)

Ordering Information

Decibel Meters Zero Power Level: 6 mW
 into 500 Ohm line. Self Shielding

Range	Approx. Impedence (Ohms) at 60 Hz	Model/Catalog Number		
		2-1/2" Model 2142	3-1/2" Model 2143	4-1/2" Model 2144
-10 to + 6 dB	5000	17465	17549	17648

Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	17-18
AC Voltage	C	43-44
DC Current	C	77-78
DC Voltage	C	105-106
RF Current	C	161-162
VU	C	171-172
Watts	C	182-183

Ordering Information

Decibel Meters Zero Power Level: 6 mW into 500 Ohm line. Self Shielding

Range	Approx. Impedance (Ohms) at 60 Hz	Model/Catalog Number	
		2-1/2" Model 145	3-1/2" Model 45
-10 to + 6 dB	5000	<>	<>

<> Available on special order.

Range	Approx. Impedance (Ohms) at 60 Hz	Model/Catalog Number	
		2-1/2" Model 145	3-1/2" Model 45
-10 to + 6 dB	5000	<>	<>

For your convenience, the table below lists Round models for other electrical monitoring functions and page reference.

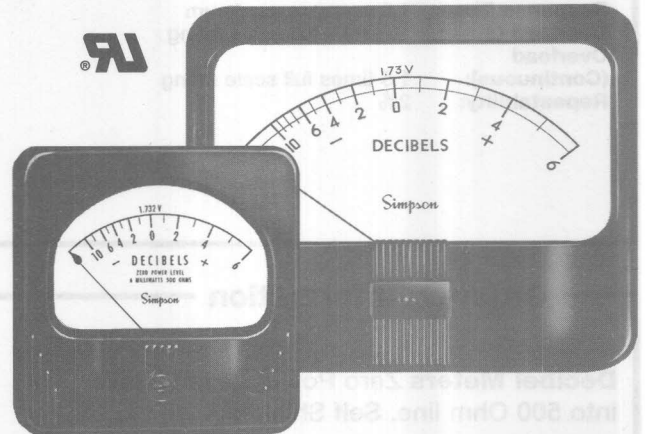
**C
1
3
4**



Decibel Meters

Rectangular Style

- Zero Power Reference Level of 6 mW into 500 ohms
- Phenolic Case with Glass Window
- Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"
- Scale Span From Minus 10 to Plus 6 dB
- $\pm 3\%$ Full Scale Accuracy
- UL Recognized

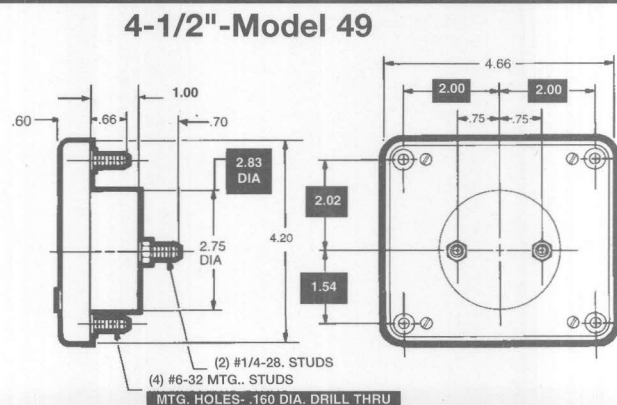
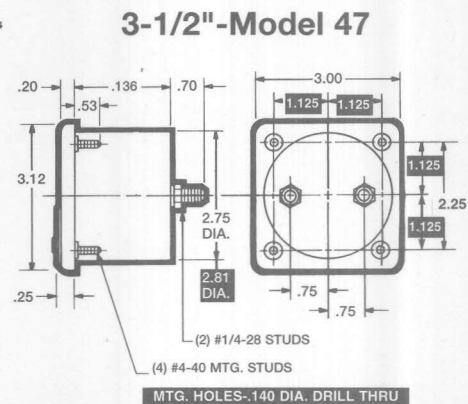
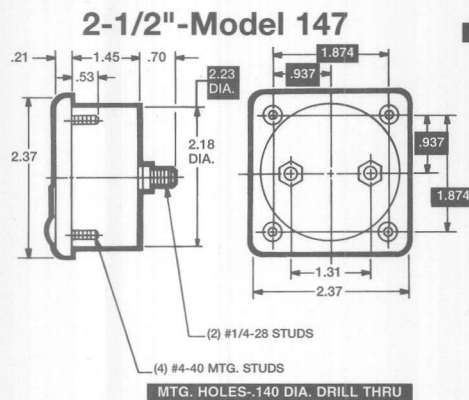


Model Number	Size	Meter Movement
147	2-1/2"	Annular-Rectifier
47	3-1/2"	Annular-Rectifier
49	4-1/2"	Annular-Rectifier

Look to the Rectangular style dB meter for reliable measurement of decibels in applications such as audio sound devices, stereo equipment, and many more. The round phenolic case and glass windows provide a sharp, clear appearance to your panel. The Rectangular decibel (dB) meter covers a scale span from minus 10 to plus 6 dB and are designed for use with a zero power reference level of 6 milliwatts into 500 ohms. With this zero power reference level a sinusoidal potential of 1.732 volts applied to the meter will deflect the pointer to the zero dB spot on the dial. When the sinusoidal potential is applied, the Simpson dB meter will have an internal terminal impedance of 5000 ohms.

With $\pm 3\%$ of full scale accuracy, the dB meters reflect Simpson's commitment to precision and accuracy. Available in three standard sizes of 2-1/2", 3-1/2", and 4-1/2", the Rectangular dB meters can solve your application requirements. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions



Specifications

Accuracy: $\pm 3\%$ F.S.
Movement: Annular-Rectifier
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Spade pointer, with black matte finish
Scale Length: Model 147: 1.8" (45.7mm)
 Model 47: 2.5" (63.5mm)
 Model 49: 3.9" (99.0mm)
Net Weight: Model 147: 7 oz (0.20kg)
 Model 47: 8 oz (0.23kg)
 Model 49: 11 oz (0.31kg)

Ordering Information

Decibel Meters Zero Power Level: 6 mW into 500 Ohm line. Self Shielding

Range	Approx. Impedance (Ohms) at 60 Hz	Model/Catalog Number		
		2-1/2" Model 147	3-1/2" Model 47	4-1/2" Model 49
-10 to +6 dB	5000	<>	03450	03460

<> Available on special order: Model 147 Rectangular

Function Reference Table

For your convenience, the table below lists Rectangular models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	21-22
AC Voltage	C	47-48
DC Current	C	79-80
DC Voltage	C	109-110
RF Current	C	165-166
VU	C	173-174
Watts	C	185-186



Elapsed Time Meters

Century, Round, Rectangular, Wide-Vue Style

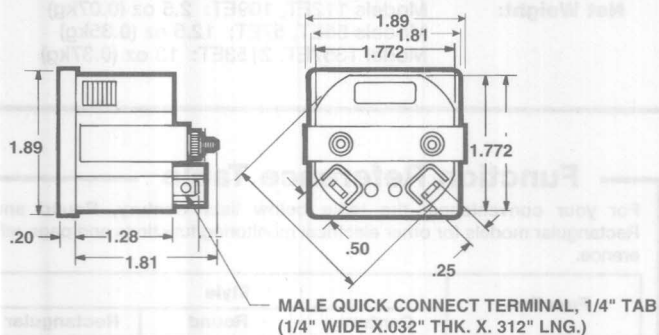
- Records the "On" Time of Electrical Equipment AC & DC Operating Voltage Units
- Phenolic Cases With Glass Windows
- Six Attractive Case Styles
- Two Popular Sizes: 1-1/2", 3-1/2"

Simpson's series of elapsed time meters feature a six-digit readout with no reset capability, making them virtually tamper proof. Each true time elapsed time meter is ruggedly constructed and records the "on" time of electrical equipment. They are widely used in factory environments where there is a need to accumulate running time and monitor life and performance records on AC and DC powered equipment. All hour meters are connected in parallel with the equipment being monitored. The synchronous motor provides accurate hour indication. Model 109ET has a 10-80 V DC input as a standard feature. An optional plug-in AC converter module can also be ordered with the model 109 ET. Choose from Century, Wide-Vue, Rectangular or Round case styling to match other instruments.

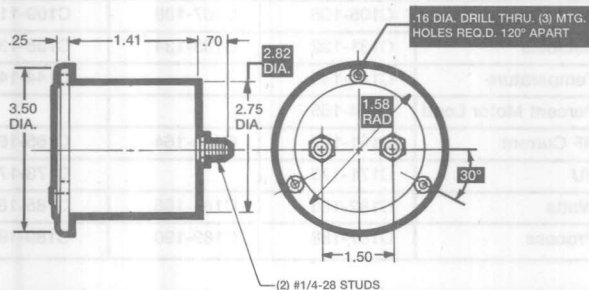
Dimensions

1 = Panel Meter Cut-out Dimensions

1-1/2"- Model 109ET



3-1/2"- Model 55ET



Model 2153ET
Century



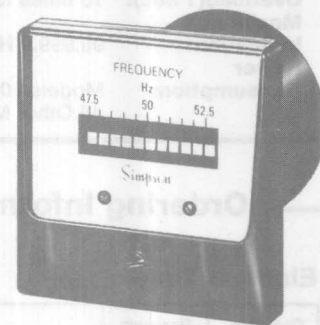
Model 112ET



Model 109ET



Model 55ET
Round



Model 1357ET
Wide-Vue



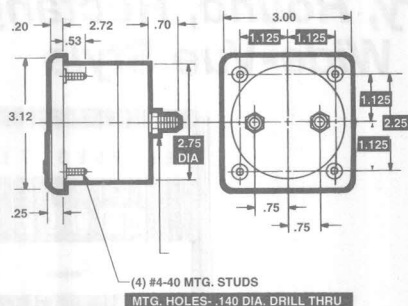
Model 57ET
Rectangular

Model Number	Size	Meter Movement
109ET	1-1/2"	Clock Motor
112ET	1-1/2"	
55ET	3-1/2"	
1357ET	3-1/2"	
57ET	3-1/2"	
2153ET	3-1/2"	

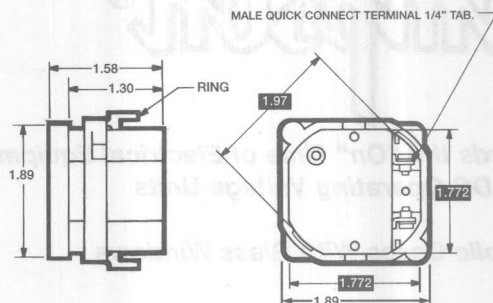
Dimensions

1 = Panel Meter Cut-out Dimensions

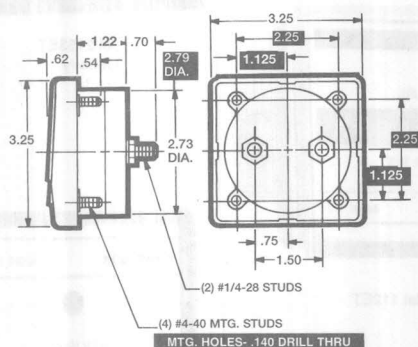
3-1/2"- Model 57ET



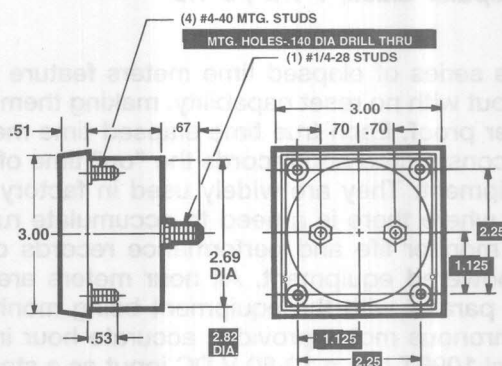
3-1/2"- Model 112ET



3-1/2"- Model 1357ET



3-1/2"-Model 2153ET



Specifications

Accuracy:	Model 109ET & 112ET: $\leq .01\%/24$ HRS. Models 55ET, 1357ET, 57ET, 2153:synchronous with AC Power
Movement:	Synchronous Clock Motor
Overload(1 sec):	10 times full scale rating
Maximum Indication:	99,999.9 Hours
Power Consumption:	Models 109ET, 112ET: .5 watts All Other Models: 2.5 watts

Case:	Models 55ET, 57ET, 2153ET: High density phenolic. Models 109ET, 112ET, 1357ET: High density black acrylic.
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Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Net Weight:	Models 112ET, 109ET: 2.5 oz (0.07kg) Models 55ET, 57ET: 12.5 oz (0.35kg) Model 1357ET, 2153ET: 13 oz (0.37kg)

Ordering Information

Elapsed Time

Operating Voltage (± 10)	Maximum Indication (hours)	Power Consumption	Accuracy	Model Size	Model Number	Catalog Number
10-80 VDC*	99,999.9	.5 watt	$\leq .01\%/24$ hrs	1-1/2"	109ET	03618
	99,999.9	.5 watt	$\leq .01\%/24$ hrs		112ET	03622
120 VAC 60 Hz	99,999.9	2.5 watts	synchronous	3-1/2"	55ET	03580
	99,999.9	2.5 watts	synchronous		1357ET	03595
	99,999.9	2.5 watts	synchronous		57ET	03590
	99,999.9	2.5 watts	synchronous		2153ET	17720
240 VAC 60 Hz	99,999.9	2.5 watts	synchronous	3-1/2"	55ET	03600
	99,999.9	2.5 watts	synchronous		57ET	03610
	99,999.9	2.5 watts	synchronous		1357ET	03615
	99,999.9	2.5 watts	synchronous		2153ET	17721

* Model 109ET has 10-80 VDC input-standard, or 100-265 VAC, 50-1000 Hz with optional plug-in AC converter module, Cat. No. 03619.

Function Reference Table

For your convenience, the table below lists Century, Round and Rectangular models for other electrical monitoring functions and page reference.

Function	Style		
	Century	Round	Rectangular
AC Current	C17-18	C19-20	C21-22
AC Voltage	C43-44	C45-46	C47-48
DC Current	C75-76	C77-78	C79-80
DC Voltage	C105-106	C107-108	C109-110
Decibels	C131-132	C133-134	C135-136
Temperature	C144-145		C144-146
Percent Motor Load	C154-155		
RF Current	C161-162	C163-164	C165-166
VU	C171-172		C173-174
Watts	C182-183	C184-185	C185-186
Process	C187-188	C189-190	C189-190



Frequency Meters

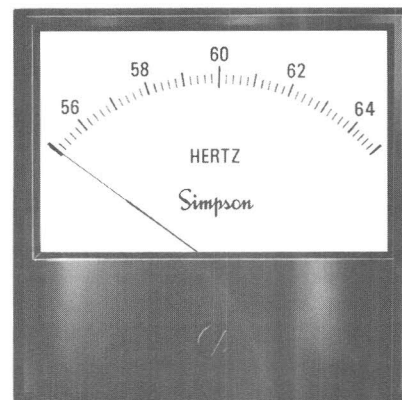
Standard Scale Segmental Century Style

■ 0.5% of Center Scale Value Accuracy

■ Easy to Read Linear Scales

■ Two Popular Sizes: 3-1/2", 4-1/2"

Simpson's Segmental Scale meters are highly accurate panel meters with easy-to-read linear scales. The frequency function Model 2183 and 2184 are ideal for monitoring line frequency. They are used wherever fast, precision monitoring of complex circuits is essential. Segmental Scale Frequency meters present a selected frequency range across the entire dial face in linear fashion. Where the significant frequency range on a conventional meter is squeezed into a quarter of an inch of space, Simpson Segmental meters distribute that range across the entire dial, making possible readings with an accuracy of $\pm 0.5\%$ of center scale value. Thus, only the important segment of the frequency range appears. The Century style offers a popular look

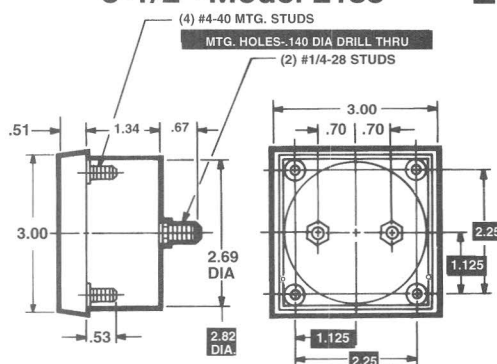


Model Number	Size	Meter Movement
2183	3-1/2"	Small Core Magnet
2184	4-1/2"	Small Core Magnet

with sharp, beveled edges and glass windows for easy viewing. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

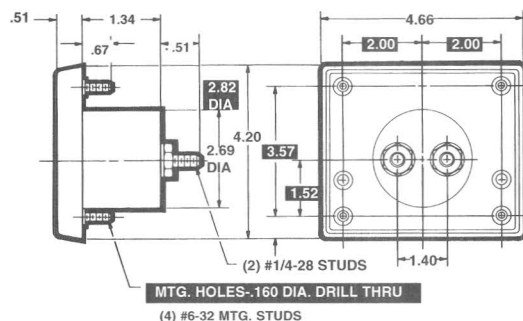
Dimensions

3-1/2"-Model 2183



1 = Panel Meter Cut-out Dimensions

4-1/2"-Model 2184



Specifications

Accuracy: 45-55 & 55-65 Hz Ranges: $\pm 0.5\%$ of Center Scale
380-420 Hz Ranges: $\pm 0.3\%$ of Center Scale

Movement: Small Core Magnet, Self shielding

Suspension: Pivot and Jewel

Shielding: Calibration is unaffected by magnetic panel mounting

Center Scale Value: 50/60/400 Hz

Power Consumption: 1.6 VA

Max. Input Voltage (10 Sec): 150 V, 110/120 V normal

Voltage Influence

108-132 volts: 45-55 Hz $\pm 0.2\%$
55-65 Hz $\pm 0.2\%$
380-420 Hz $\pm 0.12\%$

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: High density black phenolic.

Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)

Pointer: Knife edge with black matte finish.

Scale Length: Model 2183: 2.75" (69.8 mm)
Model 2184: 4.09" (103.9 mm)

Net Weight: Model 2183: 6oz. (0.17 kg)
Model 2184: 9oz. (0.26 kg)

Range	Center Scale		Model/Size and Catalog Number	
	Value	Accuracy†	3-1/2" Model 2183	4-1/2" Model 2184
45-55 Hz	50 Hz	0.5%	17920	17923
55-65 Hz	60 Hz	0.5%	17921	17924
380-420 Hz	400 Hz	0.3%	17922	17925

† Accuracy shown in percent of center scale values.

Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions with page number reference.

Function	Section	Pages
AC Voltage	C	59-60

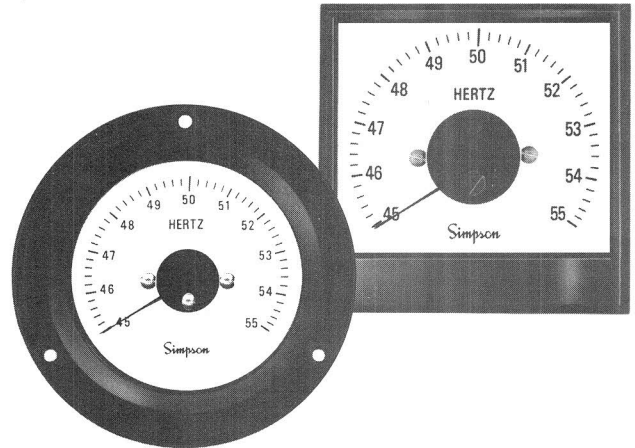
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Frequency Meters

250° Long Scale Segmental

- 0.5% of Center Scale Value Accuracy
- Phenolic and Shielded Metal Cases
- More Than Double the Scale Length
- Round and Rectangular Case Styles



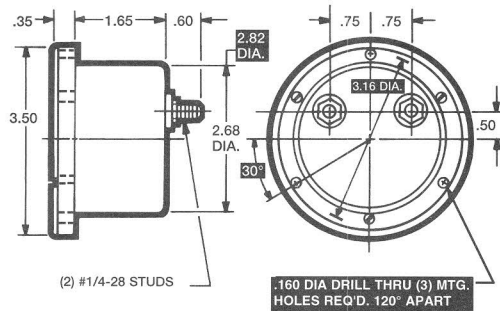
Model Number	Size	Meter Movement
2543	3-1/2	Self-Shielding
2183L	3-1/2	Self-Shielding

Look to the 250° Long Scale Segmental meters for a full 250° readability that provides more than double the scale length of the standard 90° or 100° movements. The linear scale and the small core magnet movement construction allows the segmental frequency meters to measure very small changes in input condition. Therefore, they are used wherever fast, precision monitoring of complex circuits are essential. Where the significant frequency range on a conventional meter is squeezed into a quarter of an inch of space, Simpson Segmental meters distribute that range across the entire dial, making possible readings with an accuracy of $\pm 0.5\%$ of center scale value. Thus, only the important segment of the frequency range appears. These easy-to-read meters are available in either sealed

round metal or in molded rectangular phenolic cases. The zero adjust is conveniently located on the external front portion of meter. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

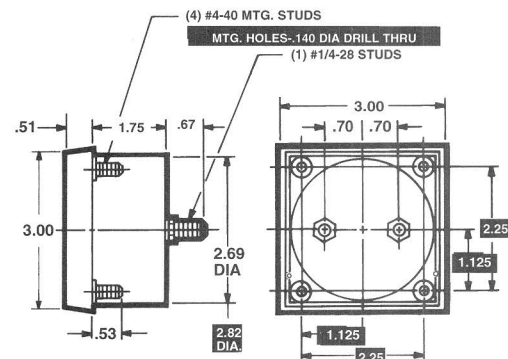
Dimensions

3-1/2"-Model 2583



1 = Panel Meter Cut-out Dimensions

3-1/2"-Model 2183L



Specifications

Accuracy: 45-55 & 55-65 Hz Ranges: $\pm 0.5\%$ of Center Scale
380-420 Hz Ranges: $\pm 0.3\%$ of Center Scale

Movement: Annular, 250° Long Scale, Self shielding

Suspension: Pivot and Jewel

Shielding: Calibration is unaffected by magnetic panel mounting

Center Scale Value: 50/60/400 Hz

Power Consumption: 1.6 VA

Max. Input Voltage (10 Sec): 150 V, 110/120 V normal

Voltage Influence

108-132 volts: 45-55 Hz $\pm 0.2\%$
55-65 Hz $\pm 0.2\%$
380-420 Hz $\pm 0.12\%$

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: Model 2543: Sealed metal case
Model 2183L: Phenolic case with glass window

Operating Temperature: -4°F to +149°F (-20°C to +65°C)

Pointer: Knife edge with black matte finish.

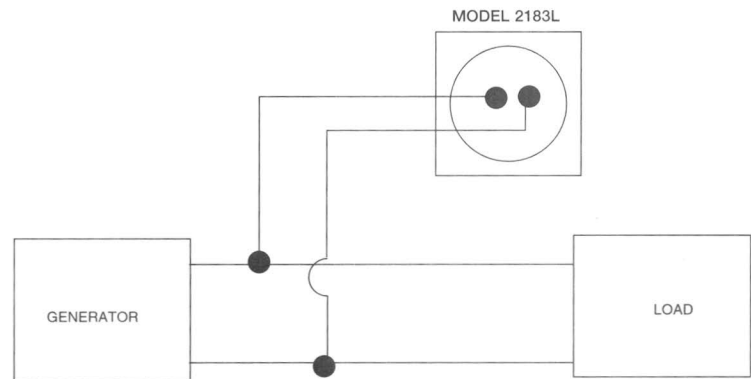
Scale Length: All models: 4.77" (121 mm)

Net Weight: All models: 8oz. (0.23 kg)

Wiring Diagram

There is a need to measure the frequency of the line voltage supplying power to particular load. The normal operational frequency range of the load is 55-65 Hertz. If the frequency level of a generator rises above 65 Hertz, the equipment will not function correctly and could damage the equipment.

A Simpson Model 2183L frequency meter is used to monitor the frequency of the generator. The meter is installed in parallel between the source (line voltage) and the load (control panel) like a volt meter. In the event that the generator is functioning poorly, a backup generator is on standby.



Ordering Information

Frequency Meters 250° Long Scale Round

Range	Center Scale		Model/Size and Catalog Number
	Value	Accuracy†	
45-55 Hz	50 Hz	0.5%	17992
55-65 Hz	60 Hz	0.5%	17993
380-420 Hz	400 Hz	0.3%	17994

† Accuracy shown in percent of center scale values.

Frequency Meters 250° Long Scale Rectangular

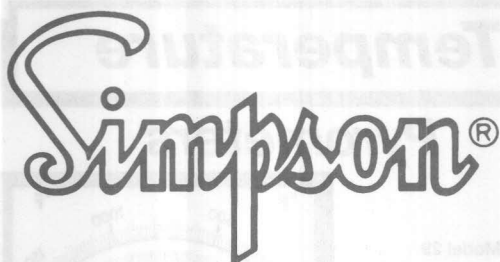
Range	Center Scale		Model/Size and Catalog Number
	Value	Accuracy†	
45-55 Hz	50 Hz	0.5%	17007
55-65 Hz	60 Hz	0.5%	17008

† Accuracy shown in percent of center scale values.

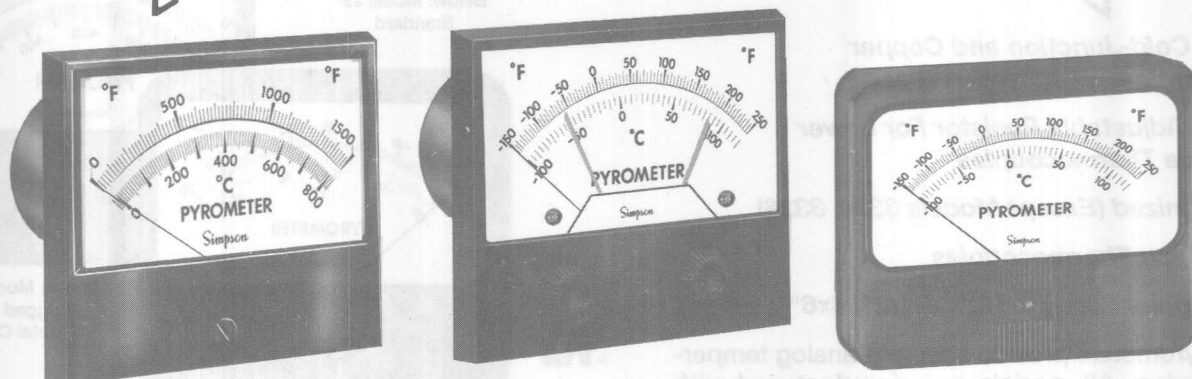
Function Reference Table

For your convenience, the table below lists 250° Long Scale models for other electrical monitoring functions with page number reference.

Function	Section	Pages
DC Voltage	C	121-122
DC Current	C	91-92
AC Voltage	C	59-60
AC Current	C	29-30



Temperature Pyrometers



Simpson Electric manufactures pyrometers in a variety of case sizes and construction to meet any application requirements. Models are available in 3-1/2", 4-1/2" and 4x6" sizes, with standard and rugged seal case styles. The 4x6" model features a mirrored seal case.

A pyrometer is essentially an instrument used for measuring elevated temperatures (beyond the range of mercury thermometers) by electrical means. Different methods include immersion, optical, radiation, resistance and thermoelectric pyrometers.

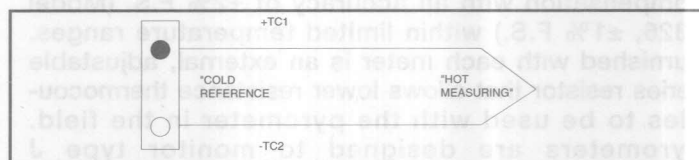
Since over half of all measurements of important variables in industrial and related fields involve measurements of temperature, more study and experimentation have been applied here than devoted to any other field of instrumentation.

Thermocouples

Simpson pyrometers use thermocouples as the temperature sensing element.

A thermocouple is a device for measuring temperature, where two electrical conductors of dissimilar metals are joined or fused at the point of heat application ("hot" end) and a resulting voltage difference, directly proportional to the temperature, is developed across the free ends ("cold" end reference). This voltage is then measured potentiometrically. Thermocouples can measure liquid, air or surface temperatures.

Thermocouples come in a variety of metal combinations or "calibrations", the four most common being J, K, T and E. Each calibration has its own voltage/temperature curve and is unique to different temperature ranges and environments, although maximum temperature can vary with the diameter of the wire used in the thermocouple.



Choosing a Thermocouple

When choosing a thermocouple, special consideration should be given to the following:

- Range of temperature to be measured.
- Chemical resistance of the thermocouple or sheath material.
- Abrasion and vibration resistance.
- Installation requirements (thermocouples may have to be compatible with existing equipment and surroundings).

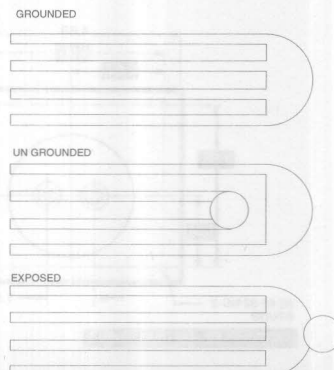
Junctions

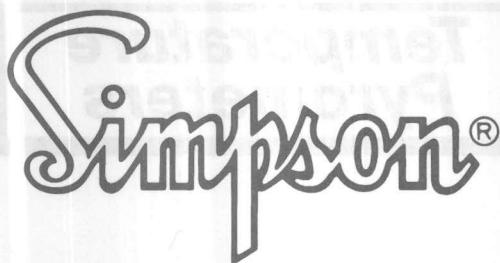
Thermocouples are sheathed for protection, typically with stainless steel or braided glass cloth, and come in three metal junction types:

Grounded: Used for measuring static or flowing corrosive gas and liquid and for high pressure applications.

Ungrounded: Used where corrosive elements are present and where it is desirable to have the thermocouple electronically isolated from and shielded by the sheath.

Exposed: Used in static or flowing non-corrosive gas temperatures where fast response time is required.





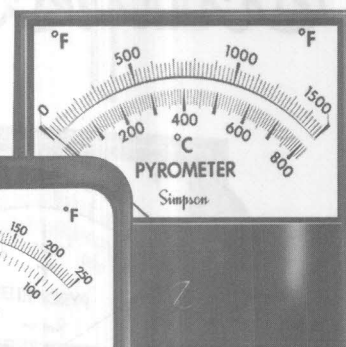
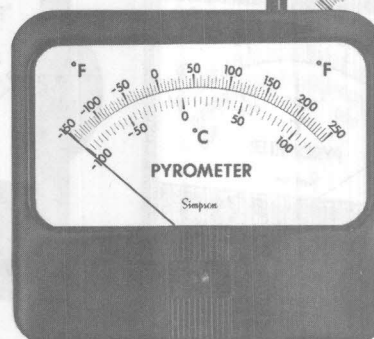
Temperature

Pyrometers

- Ambient Cold-Junction and Copper Compensation
- External, Adjustable Resistor For Lower Resistance Thermocouples
- UL Recognized (Except Models 3324, 3326)
- J and K Type Thermocouples
- Three Popular Sizes: 3-1/2", 4-1/2", 4x6"

Simpson's pyrometers provide accurate analog temperature monitoring. All models are manufactured with ambient (bi-metal) cold-junction and circuit copper compensation with an accuracy of $\pm 2\%$ F.S. (Model 3326, $\pm 1\%$ F.S.) within limited temperature ranges. Furnished with each meter is an external, adjustable series resistor that allows lower resistance thermocouples to be used with the pyrometer in the field. Pyrometers are designed to monitor type J (Iron/Constantan) and type K (Chromel/Alumel) inputs. Thermocouples are not included; see Accessory Section for details. Select from three attractive case styles: Rectangular, Century, and Rugged Seal. The Rectangular and Century styles feature phenolic cases

Below: Model 29
Standard



Above: Model 3324
Rugged Seal
Metal Case



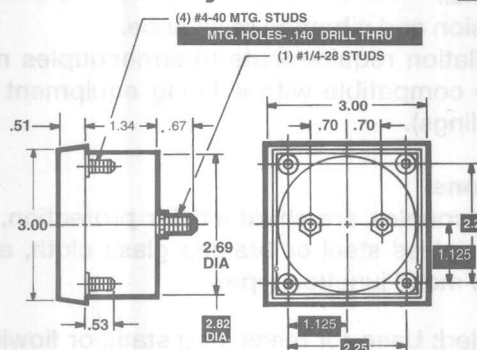
Model Number	Size	Meter Movement
2123	3-1/2"	Annular
29	4-1/2"	Annular
3324	4-1/2"	Annular
2124	4-1/2"	Annular
3326	4x6"	Annular

and glass windows. The Rugged Seal style pyrometers, with their metal case design, are moisture, dirt, and dust proof for use in rigorous environmental conditions. A variety of ranges are available in degrees F or degrees C to compliment your measurement application.

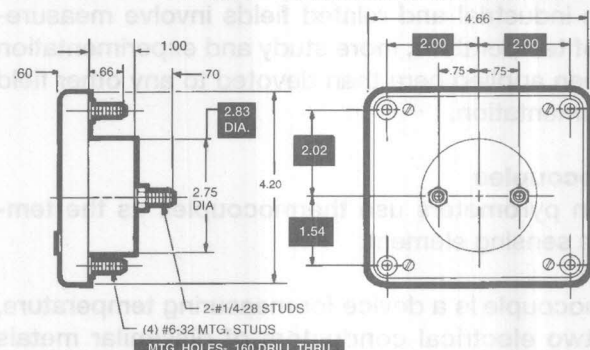
Dimensions

3-1/2"-Century Model 2123

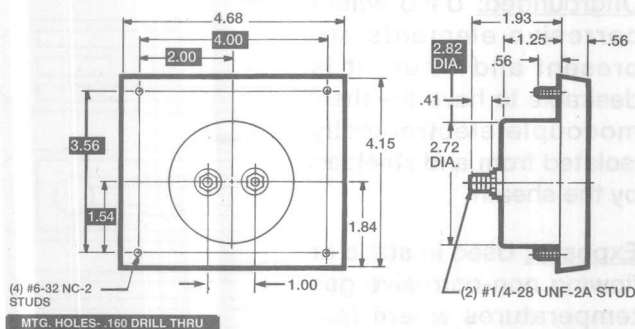
1 = Panel Meter Cut-out Dimensions



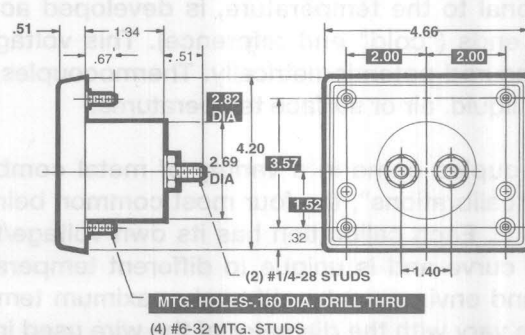
4-1/2"-Standard Model 29



4-1/2"-Rugged Seal Model 3324



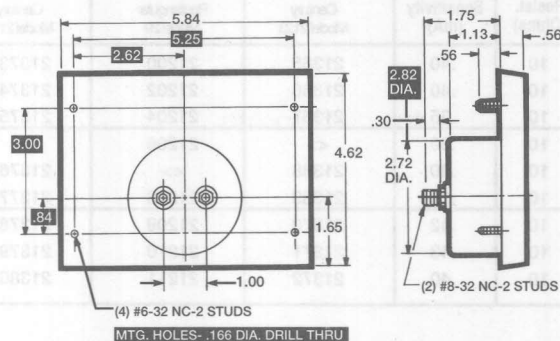
4-1/2"-Century Model 2124



Dimensions

1 = Panel Meter Cut-out Dimensions

4x6"-Rugged Seal Model 3326



Specifications

Accuracy: Meters with ranges of -150° to +250°F and 0° to 300°F: $\pm 2\%$ ($\pm 1\%$ for Model 3326) between 50° and 90°F; Meters with ranges of 0° to 500°F and 0° to 750°F: $\pm 2\%$ F.S. ($\pm 1\%$ F.S., 3326) between 40°F and 100°F. All other ranges: $\pm 4\%$ F.S.

Movement: Annular, Self-shielding

Suspension: Pivot and Jewel or Taut Band

Tracking: $\pm 3\%$

Shielding: Calibration is unaffected by magnetic panel mounting.

Response Time: 1.5 seconds maximum

Overload (1 sec.): 10 times full scale rating

Overload (Continuous): 1.5 times full scale rating

Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance: $\pm 15\%$

Operating Temperature: -4°F to +149°F (-20°C to +65°C)

Case: Models 29, 2123, 2124: High density black phenolic. Models 3324, 3326: Metal Cover and case with Black Matte Finish Trim Knife Edge with Black Matte Finish

Pointer:

Scale Length: Model 29: 3.9" (99.0mm)
Model 2123: 2.75" (69.8mm)
Model 2124: 4.09" (103.9mm)
Model 3324: 4.05" (103.0mm)
Model 3326: 4.94" (125.0mm)

Net Weight: Model 29: 11 oz (0.31kg)
Model 2123: 8oz (0.23kg)
Model 2124: 11 oz (0.31kg)
Model 3324: 17 oz (0.48kg)
Model 3326: 19 oz (0.54kg)

C
1
4
5

Wiring Diagram

Connection of Pyrometers Using 10 Ohm Thermocouples

Simpson pyrometers are designed to be used with 10 ohm type J or K thermocouples. Before hookup to meter, remove adjustable resistor assembly from box and keep for future use. Connect plus lead of thermocouple to left-hand terminal and minus lead thermocouple to right-hand terminal is viewed from rear of panel meter.

Connection of Pyrometers Using Other Thermocouples

All Simpson pyrometers are calibrated for a thermocouple circuit resistance of 10 ohms. If the thermocouple circuit resistance is not properly adjusted, an additional error will be introduced.

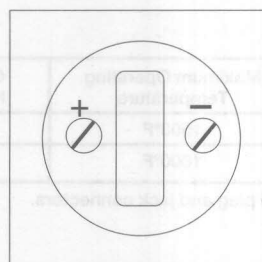
To use a thermocouple with a resistance of less than 10 ohms, a series resistor must be used. For your convenience an external resistor assembly is included in the meter box. Attach the external resistor assembly to the meter terminals as shown on the disk of the external resistor assembly. The connection of the thermocouple to the external resistor assembly is as follows:

Connect plus (+) lead of thermocouple to the lower left terminal (see figure). Check thermocouple with Wheatstone bridge for exact ohms and reduce the resistance of the nylon spool by an amount equal to the resistance of the thermocouple. The thermocouple resistance plus the remaining resistance on the spool must equal 10 ohms. To check the resistance, the connection shown in the figure to the right is recommended.

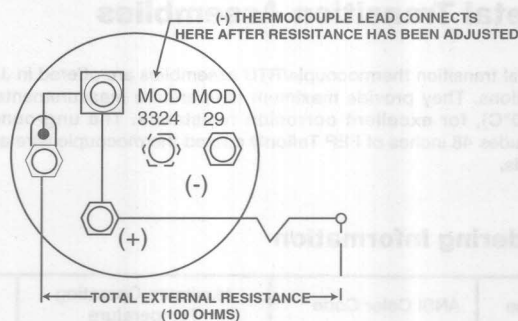
To help in adjusting the external resistance, the spool is designed to have a resistance of approximately .2 ohms per turn or .02 ohms per kink (1/4 turn) or approximately 50 turns for 10 ohms.

To adjust the external resistor, loosen the binding post, unwind necessary amount of turns, cut to that length, strip insulation, and connect to binding post again.

Connect minus (-) lead of thermocouple to right-hand terminal (see figure) and pyrometer is ready for use.



REAR VIEW
OF PANEL



Ordering Information

Temperature Range		Thermo- couple Type Required†	Max. External Resist. (Ohms)	Approx. Sensitivity (mA)	Model/Size and Catalog Number				
°F	°C				3-1/2" Century Model 2123	4-1/2" Rectangular Model 29	4-1/2" Century Model 2124	4-1/2" Rugged Seal Model 3324	4x6" Mirrored Rugged Seal Model 3325**
-150 to +250*	-100 to +120*	J(I/C)	10	.40	21365	21200	21373	21201	21381
0 to +300*	-20 to +150*	J(I/C)	10	.40	21366	21202	21374	21203	21382
0 to +500*	-20 to +260*	J(I/C)	10	.35	21367	21204	21375	21205	21383
0 to +750*	-20 to +400*	J(I/C)	10	.30	<>	21206	<>	21207	<>
0 to +800	-20 to +425	J(I/C)	10	.30	21368	<>	21376	<>	21384
0 to +1000	-20 to +540	J(I/C)	10	.28	21369	21208	21377	21212	21385
0 to +1500	-20 to +820	K(C/A)	10	.42	21370	21209	21378	21213	21386
0 to +2000	-20 to +1100	K(C/A)	10	.43	21371	21210	21379	21214	21387
0 to +2500	-20 to +1380	K(C/A)	10	.40	21372	21211	21380	21215	21388

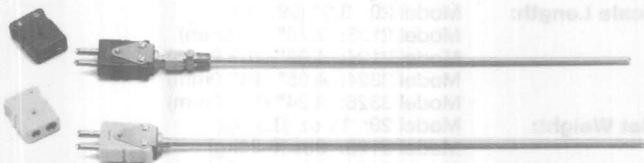
* Taut-Band.

** 1% Accuracy.

<> Available on special order.

† Thermocouple not supplied with pyrometer. I/C and C/A types are available from stock as accessory items (see below).

Accessories



Quick Disconnect Assemblies

Quick disconnect thermocouple assemblies are fast-responding, durable, and capable of handling higher temperatures than uninsulated types. The 12 inch, 3/16 in. diameter thermocouple probe has an ungrounded junction and is made of 316 stainless steel.

Ordering Information

Type	ANSI Color Code	Maximum Operating Temperature	Catalog Number
J	Black	1500°F	21238
K	Yellow	1600°F	21239

Note: All selections include standard plug and jack connectors.

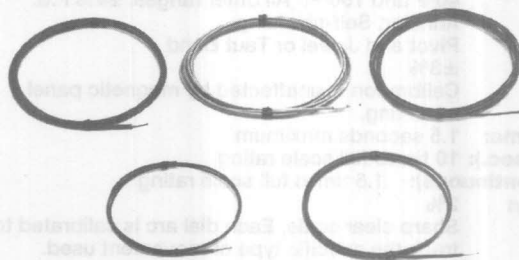


Metal Transition Assemblies

Metal transition thermocouple/RTD assemblies are offered in J and K calibrations. They provide maximum temperature measurements of 1650°F (900°C), for excellent corrosion resistance. The ungrounded probe includes 48 inches of FEP Teflon® coated thermocouple wire and stripped leads.

Ordering Information

Type	ANSI Color Code	Maximum Operating Temperature	Catalog Number
J	Black	1500°F	21242
K	Yellow	1600°F	21243



Insulated Soft Wire-Standard and Custom

Soft-wire thermocouples are available in five insulation types, in custom lengths for special applications, and in varying gauge sizes. All soft wire selections have beaded butt welded measurement junctions. For cold junction terminations, standard thermocouple selections have eye terminal (1/4" screw size) for use with analog meters and custom thermocouples have solid bare wire.

Ordering Information

Standard

Cat. No.	T/C Type	Resistance	Overbraid	Length	Gauge
21221	J	5 ohms	GBS	162"	20
21222	J	10 ohms	DGW	137"	24
21223	J	10 ohms	DGW	34"	30
21224	J	10 ohms	GBS	325"	20
21231	K	10 ohms	GBS	154"	20
21232	K	10 ohms	DGW	90"	24

Custom

TH	Thermocouple Type	Wire Gauge Size	Insulation Type (see table)	Thermocouple Length (feet)
J	J	0	GB	20
K	K	1	GBS	24
		2	DGW	
		3	FEP	

Thermocouple Insulation Types Available

Type	T/C Type	Gauge Size
GB	J, K	20, 24
GBS	J, K	20
DGW	J, K	24
FEP	J, K	20

GB = Glass Braid
GBS = Glass Braid w/Stainless Steel Wrap
DGW = Double Glass Wrap
FEP = HighTemp. Plastic Equal to Teflon®



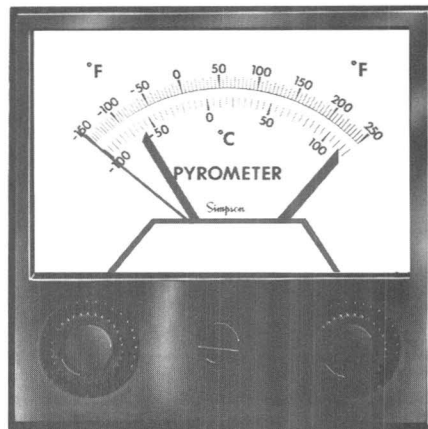
Temperature

Rugged Seal Controller

- **Electronic Cold Junction Compensation**
- **Thermocouple Resistance from 0 to 100 ohms**
- **Amplified, 1 Milliamp High Torque Meter Movement**
- **Designed for Type J and Type K Thermocouple Inputs**
- **Solid-State Circuitry**
- **Metal Cased and Shielded**
- **Single and Dual Setpoints**
- **Calibration Not Affected by Steel Panel Mounting**
- **Dual Scale Dial = Celsius and Fahrenheit**

For complete temperature control, look to the Model 3324AIXA temperature controller. The 33 Series temperature controllers feature high impedance, solid-state circuitry that eliminates thermocouple lead length adjustments. Each unit has electronic cold junction compensation for accurate compensation for differences between unit temperature and ice point. Type J and K thermocouple inputs with resistances from 0 to 100 ohms may be used with the meter. Thermocouples are not included; see Accessory Section for details.

The 3324AIXA controller is available for either single or dual setpoint control and can be used for either Celsius or Fahrenheit applications. They incorporate an amplifier input which drives a rugged 1 milliamp high torque



Model Number	Size	Meter Movement
3324AIXA-SSP	4-1/2"	Annular
3324AIXA-DSP	4-1/2"	Annular

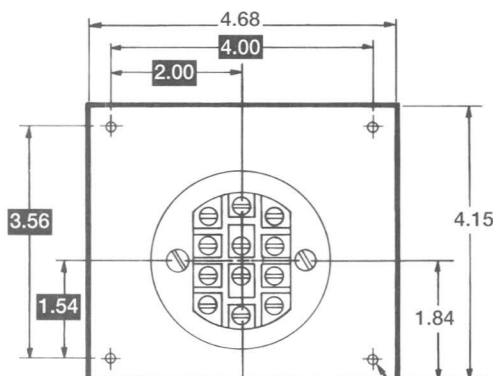
meter movement. The diecast metal case is shielded and can be mounted in steel panels without effect to the controller's calibration. In addition, each controller is moisture, dust, and dirt proof and recommended for use in wash down areas. Refer to the "Function Reference Table" herein for the page number to obtain more information for a specific function.

C
1
4
7

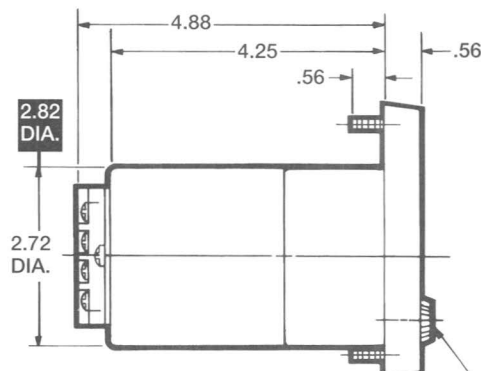
Dimensions

1 = Panel Meter Cut-out Dimensions

4-1/2"- Model 3324AIXA-SSP & 3324AIXA-DSP



(4) #6-32 NC-2 STUDS
MTG. HOLES-.160 DIA. DRILL THRU



RELAY ADJUST BUTTON .75 DIA. PROTRUDING .18 ABOVE BEZEL, LOCATED .97 BELOW METER CENTER LINE, AND .98 LEFT AND/OR RIGHT OF THE METER CENTER LINE AS

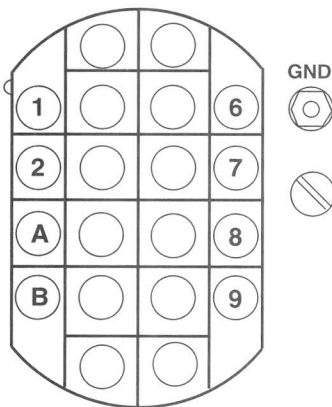
Specifications

Accuracy: $\pm 2\%$ of F.S.
Movement: Annular, Self-shielding
Suspension: Pivot and Jewel
Adjustments: Single, 0-100% of arc; double, low limit 0-95% of arc; high limit, 5-100% of arc. Adjustable to within 4° of each other.
Switching: Within 1% of indication
Differential: "On", "Off" difference is within 0.5% of F.S.
Auto/Manual Reset: Latching function can be enabled independently for each relay by removing jumpers on terminal block.
Contacts/Output Relays: DPDT relay contacts for each control point. Each set of contacts rated at 5 amps, 115 VAC.

Frequency Response: 50-1000 Hz
Power: 108-132 VAC, 50-400 Hz.
Operating Temperature: -4°F to $+149^\circ\text{F}$ (-20°C to $+65^\circ\text{C}$)
Circuit-to-Ground Voltage: 250 RMS maximum
Case: Sealed metal, plastic window.
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance: $\pm 15\%$
Tracking: $\pm 3\%$

Wiring Diagram

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
 B. - SIGNAL INPUT
 1. AUTO/MAN. RESET HI SETPOINT
 2. SHORT FOR AUTO
 6. AUTO/MAN. RESET LO SETPOINT
 7. SHORT FOR AUTO
 8. 120 VAC $\pm 10\%$
 9. 50-400 Hz
 9. ± 4 VA

Auto/Manual Reset

There are two modes of relay logic available in the 3324AIXA: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is energized when the pointer exceeds the high setpoint, and is automatically de-energized when the pointer again drops below the setpoint. The low setpoint relay is energized when the pointer drops below the low setpoint, and is automatically de-energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other setpoint. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent pushbuttons are usually used. However, one master reset button may be used for both setpoints provided it is a double pole switch with no electrical connection between poles.

Input Signal: Input to be monitored is connected to terminals A(+) and B (-).

Input Power: The power source used is 120VAC $\pm 10\%$, 50 to 400 Hz. The power requirement is nominally 4VA. Connect power source to terminals 8 and 9.

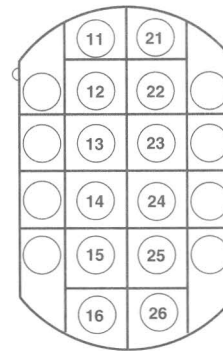
Relays

Relays can be used to “turn on” or “turn off” power to a process that the 3324AIXA is monitoring. A light can be “turned on” when a setpoint is exceeded, alerting the operator to change in condition in the process. The controller’s relays for both single and dual setpoint meters are double pole, double throw relays.

High Setpoint: The high setpoint relay contacts (on both single and dual setpoint meters) are de-energized when the pointer is above the desired setpoint. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (appear on dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminals 21 and 24. Terminals 22 and 25 are moving contacts or common. Use terminals 23 and 26 for normally closed relays.

REAR VIEW OF HEADER



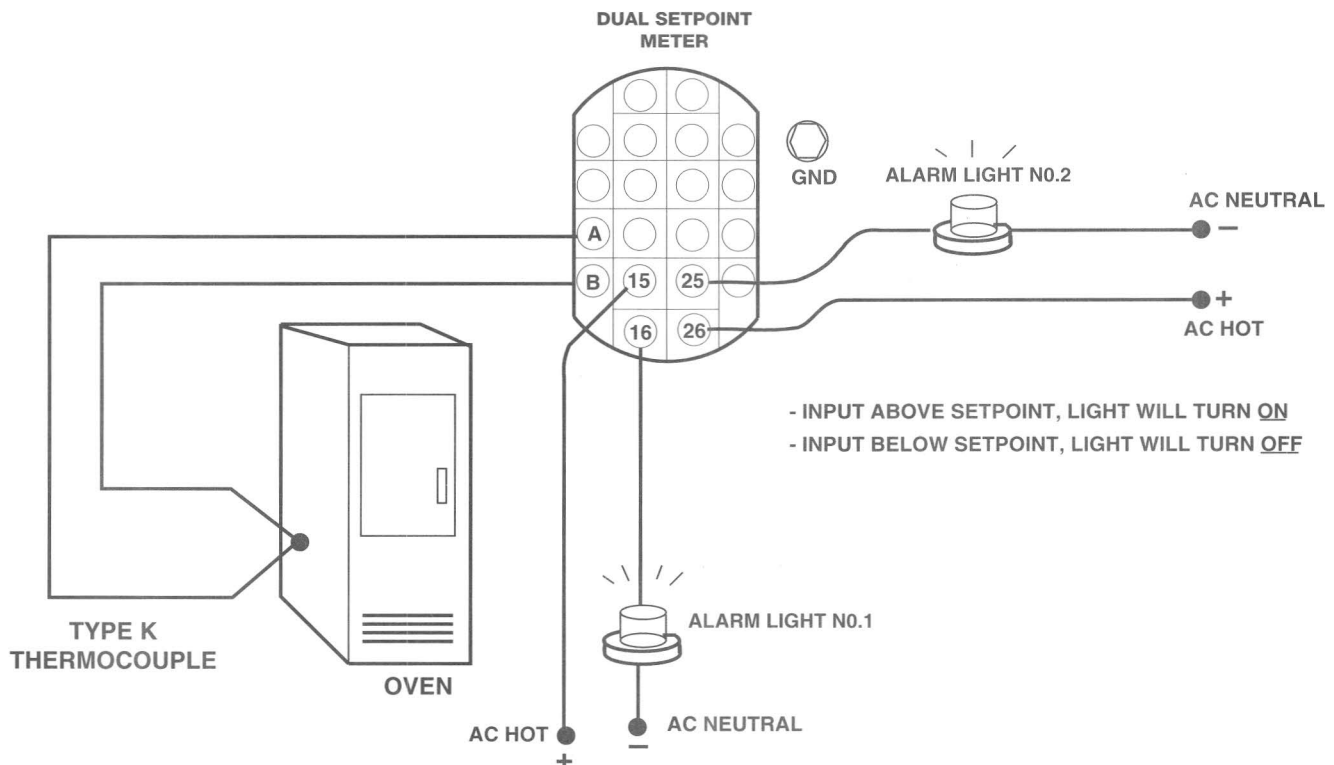
TERMINAL DESIGNATIONS

11. NO	HIGH SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER ABOVE SETPOINT.
12. C	
13. NC	
14. NO	LOW SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER BELOW SETPOINT.
15. C	
16. NC	
21. NO	HIGH SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER ABOVE SETPOINT.
22. C	
23. NC	
24. NO	LOW SETPOINT. RELAY IS DE - ENERGIZED WITH POWER POINTER BELOW SETPOINT.
25. C	
26. NC	

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Application Example

C
1
4
9



A kiln oven is used to test military aircraft wiring harnesses. The harness test procedure specifies an oven temperature of 2000°F. An alarm is specified, to alert the operator if the oven temperature either exceeds 2100°F or falls below 2000°F, or in the event of a thermocouple failure.

A type K thermocouple is installed with a Model 3324AIXA dual setpoint controller. The setpoints are adjusted appropriately to the specified requirements. If the temperature goes above 2100°F or drops below 2000°F the relay will de-energize and will “turn on” an alarm light that will alert the maintenance team to this change in condition.

The thermocouple lead wires are connected to Terminal A(+) and Terminal B(-) on back of the controller. The relay contacts for a normally closed state are Terminals 15 (common) and 16 (normally closed) for the Hi setpoint and Terminals 25 (common) and 26 (normally closed) for the Low setpoint.

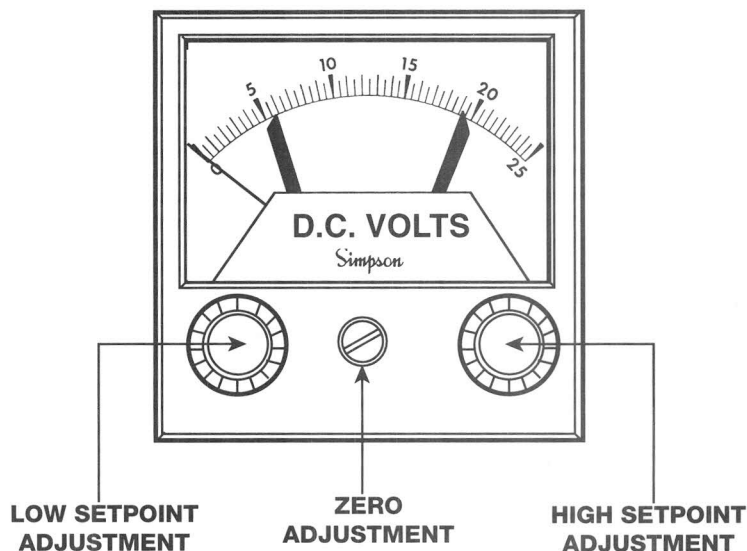
Adjustments

Setpoint Adjustment

Low and High Setpoint- To adjust dual set point units for low range, turn the adjustment knob at the left on the front face of the meter until the wide red pointer indicates the desired reading (low from 0-95% of arc). High range adjustments are made by turning the black knob at the right on the front face of the meter (Hi from 5-100% of arc).

Mechanical Pointer Adjustment

Make sure that all power to the meter has been shut down. For mechanical pointer adjustment, simply turn the slotted adjustment knob which is flush with the front panel. After adjusting the pointer, turn the knob back a few degrees in the direction opposite from your final adjustment. This frees the mechanical adjust from the pointer mechanism.



Ordering Information

Temperature Meter Relays - 33 Series Model 3324AIXA

Temperature Range	Thermocouple Type	Catalog Number	
		SSP	DSP
-50 to +275°F (-45°C to +135°C)	Type J Iron Constantan	21650	21610
0 to 300°F (0°C to +149°C)		21651	21611
0 to 500°F (0°C to +260°C)		21652	21612
0 to 750°F (0°C to +399°C)		21653	21613
0 to 1000°F (0°C to +538°C)		21654	21614
0 to 1500°F (0°C to +815°C)	Type K Chromel/Alumel	21655	21615
0 to 2000°F (0°C to +1093°C)		21656	21616
0 to 2500°F (0°C to +1371°C)		21657	21617

Thermocouples are not supplied. Available separately from Accessory Section

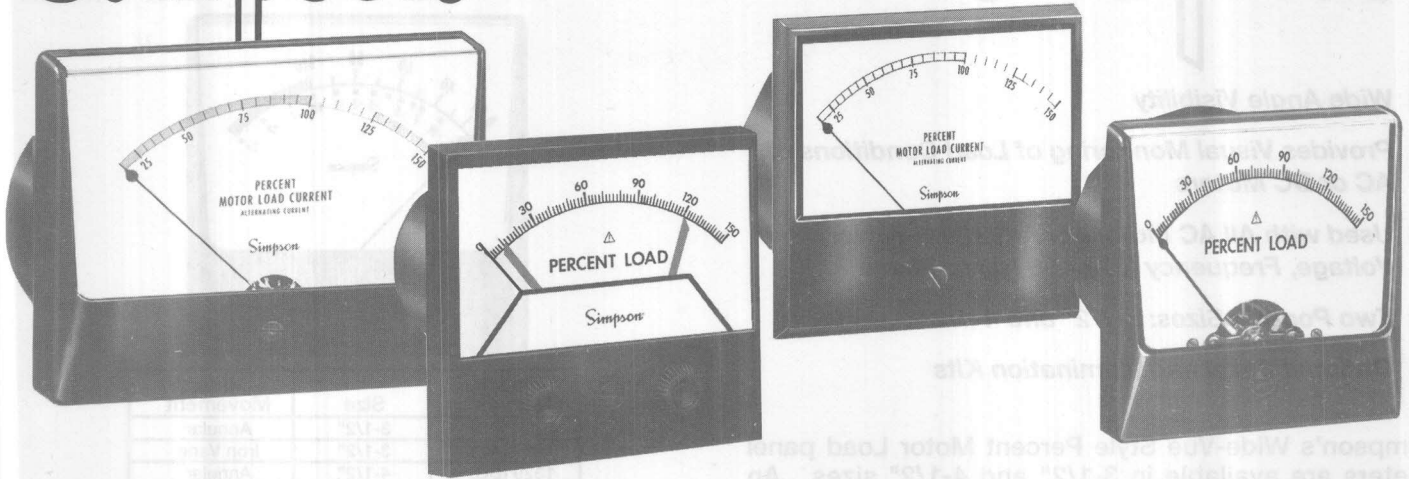
Function Reference Table

For your convenience, the table below list Rugged Seal Controller models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	33-36
AC Voltage	C	65-68
DC Current	C	95-98
DC Voltage	C	125-28
Motor Load Relays	C	156-58

Simpson®

Percent Motor Load



Simpson's Percent Motor Load panel meters provide visual monitoring of load conditions of AC or DC motors while running. Meter scales show percent load from 0 to 150%; scale is green 0-100%, yellow 100-125%, red 125-150%. They feature Simpson's "stay accurate" performance and a $\pm 2\%$ of full scale accuracy. AC load meters can be used with all AC motors of any horsepower, voltage, commercial frequency or phase. Select from two different styles of Wide-Vue and Century to measure motor load with a rating of 30mV for DC load meters and 5 amps for AC load meters. The Wide-Vue features modern styling with a durable, open faced acrylic cover for wide-angle readability and protection of the meter face. The Century series offer easy reading and attractive design with black phenolic housing and a large glass viewing window. Both styles are available in 3-1/2" and 4-1/2" sizes.

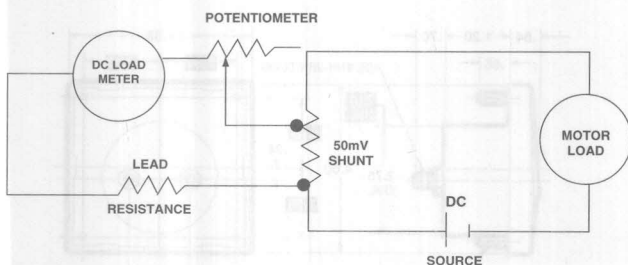
For field adjustment, DC load meters require an external shunt and potentiometer while AC load meters require an external donut transformer. Shunts and Current Transformers are sold separately. Please see Accessory Section to obtain more information on Simpson's shunts and current transformers. All AC

meters have Moving Iron Vane Movements. The moving element rides on specially hardened, polished steel pivots rotating in spring-loaded jewels. DC meters are constructed with the Annular Meter Movement which has excellent magnetic properties that are stable even under the most severe shock and vibration conditions.

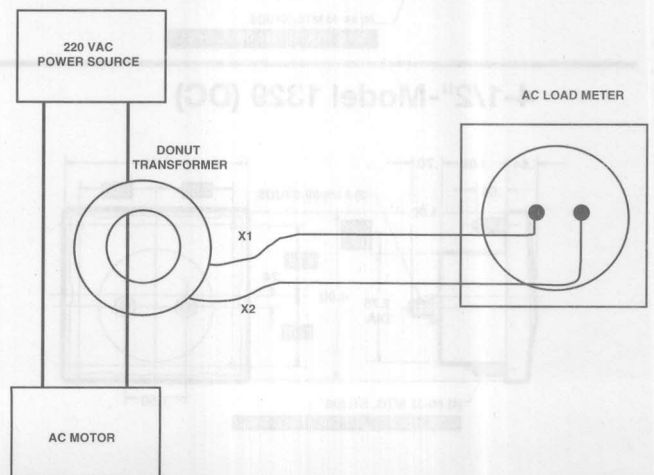
For motor load relay monitoring, Simpson's 33 Series provides on/off control functions such as single and double setpoints and time delay. The 33 Series Motor Load Meter Relays have a built in adjustment potentiometer which eliminates winding turns on the current transformer. In addition, the meter can be field adjusted to match the rated load current for a motor with the 100% mark on the scale. The metal cased construction withstands rigorous environmental conditions and is moisture, dust, and dirt proof. The Annular-Rectifier movement offers $\pm 3\%$ of full scale accuracy.

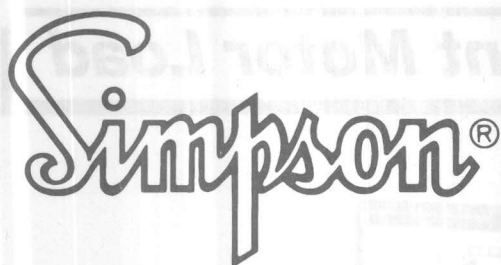
Simpson's Percent Motor Load meters can help prevent overloading and motor burn-out and establish and maintain optimum operating load conditions.

DC Percent-Load Meter with Shunt—Wiring Diagram



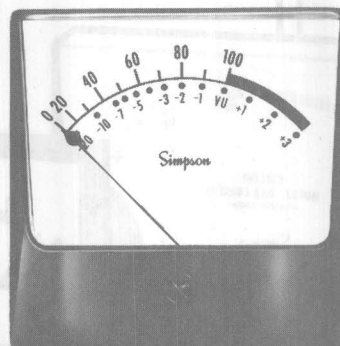
AC Percent-Load Meter with Current Transformer—Wiring Diagram





Percent Motor Load

Wide-Vue Style



- Wide Angle Visibility
- Provides Visual Monitoring of Load Conditions of AC or DC Motors
- Used with All AC Motors of Any Horsepower, Voltage, Frequency (50 or 60 Hz) or Phase
- Two Popular Sizes: 3-1/2" and 4-1/2"
- Optional Bezel and Illumination Kits

Model Number	Size	Meter Movement
1327 (DC)	3-1/2"	Annular
1357 (AC)	3-1/2"	Iron Vane
1329 (DC)	4-1/2"	Annular
1359 (AC)	4-1/2"	Iron Vane

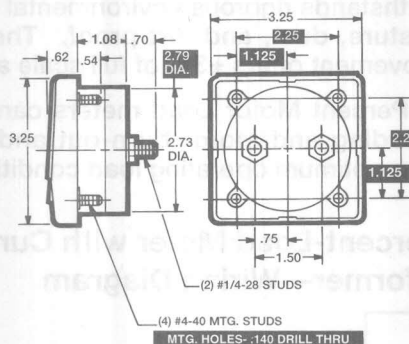
Simpson's Wide-Vue Style Percent Motor Load panel meters are available in 3-1/2" and 4-1/2" sizes. An attractive design with wide angle visibility, the Wide-Vue Style provides visual monitoring of load conditions of AC & DC motors while running. Such monitoring can prevent overloading and motor burn-out and establish and maintain optimum operating load conditions. This style meter can either be surface mounted or bezel mounted (semi-flush mount) with one of Simpson's Wide-Vue bezel kits. Scales show percent load from 0 to 150%. Scale is green from 0 to 100%; yellow from 100 to 125%, and red from 125 to 150%. AC Load meters can be used with all AC motors of any

horsepower, voltage, frequency (50 or 60 Hz) or phase. DC load meters require an external shunt and potentiometer while AC load meters require an external current transformer. Simpson's external shunts and transformers are sold separately. All AC meters have Moving Iron Vane movements that are magnetically damped and can be used for non-sinusoidal wave forms, and where economy is essential. DC units have Annular Movements that are stable even under the most severe shock and vibration conditions.

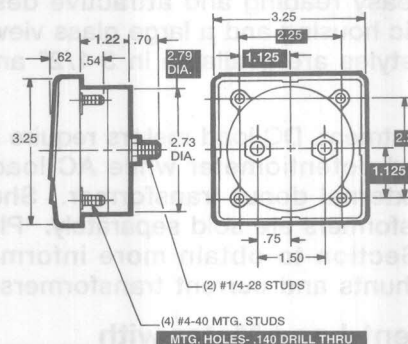
Dimensions

3-1/2"-Model 1327 (DC)

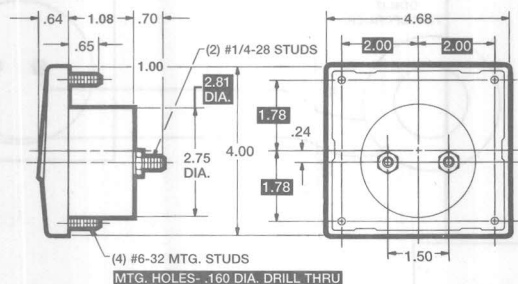
1 = Panel Meter Cut-out Dimensions



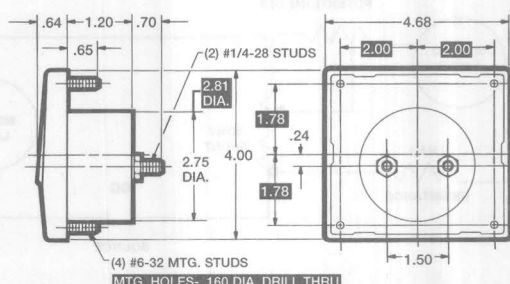
3-1/2"-Model 1357 (AC)



4-1/2"-Model 1329 (DC)



4-1/2"-Model 1359 (AC)



Specifications

Accuracy:	±2% F.S.
Movement:	Models 1357, 1359: Iron Vane, Magnetically damped Models 1327, 1329: Annular, Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Repeatability:	2%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum above 10 mA
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic.
Operating Temperature:	-4 °F to +149 °F (-20 °C to +65 °C)
Resistance:	±15%
Scale Arc:	90°
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 1327/1357: 3.14" (79.7mm) Model 1329/1359: 3.93" (100.0mm)
Net Weight:	Model 1327: 8 oz (0.23kg) Model 1329: 9 oz (0.26 kg) Model 1357: 5 oz (0.37 kg) Model 1359: 6 oz (0.17kg)
NOTE:	Meters meet ANSI specification C-39.1

Ordering Information

Percent Motor Load Wide-Vue Panel Meters

Type	Rating	Model/Size and Catalog Number			
		3-1/2" Model #	Catalog #	4-1/2" Model #	Catalog #
DC (Note 1)	30 mV	1327	07028	1329	07029
AC (Note 2)	5 amps	1357	03171	1359	03301

Note 1: DC load meters require an external shunt and an 8 to 10 Ω, 2 watt wire-wound potentiometer (customer supplied). The appropriate shunt should be selected from accessory section and ordered separately. To select the proper shunt, first obtain the full-load current rating of your motor from the name plate, manufacturer's specifications of N.E.C. listing. Multiply that rating by 1.25 and select and order the shunt with an "amps" rating as large or slightly larger than the calculated value.

Note 2: AC load meters must be used with external donut transformers listed below.

If assistance in selecting the appropriate transformer and determining the correct primary/secondary turns ratio is required, contact a Simpson technical service representative or authorized service center by calling (708) 697-2260.

Function Reference Table

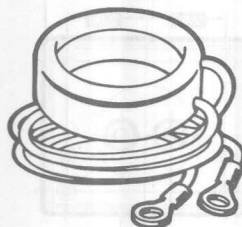
For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	13-14
AC Voltage	C	39-40
DC Current	C	71-72
DC Voltage	C	101-102
Decibels	C	129-130
RF Current	C	159-160
VU	C	169-170
Watts	C	180-181

Accessories

AC Motors

Donut Transformer



Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

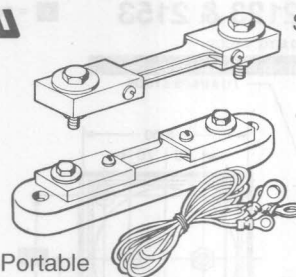
A Donut Current Transformer enables this meter to monitor motors with current ratings up to 1000 amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Wide-Vue Bezel and Illumination Kits

Bezels are available for Wide-Vue style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered separately.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas. For more Detailed Information see the accessory section.

External Portable and Switchboard Shunts



Switchboard

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have phenolic base and accept up to 200 amperes. Accuracy ±1%, 5' leads (0.065 Ω resistance) included.

Portable Shunts 50 mV

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts 100 mV

Amps	Cat.Number
10	06716
100	06717

NOTE: 5' leads not included

Switchboard Shunts 50 mV

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

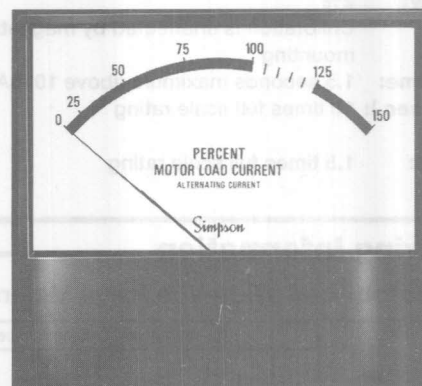
Ordering Information

Model Number	Catalog Number
1357 (3-1/2") Bezel	01253
1359 (4-1/2") Bezel	01123
1359 Illumination Kit	01165



Percent Motor Load

Century Style



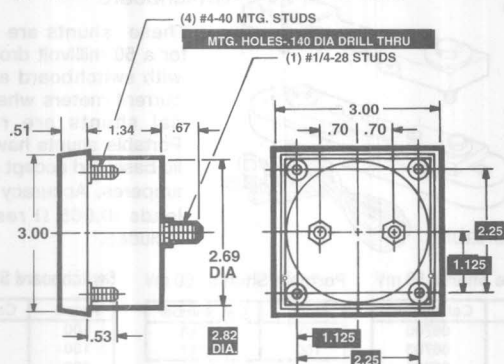
Model Number	Size	Meter Movement
2123	3-1/2"	Annular
2153	3-1/2"	Iron Vane
2124	4-1/2"	Annular
2154	4-1/2"	Iron Vane

while AC load meters require an external current transformer. Simpson's external shunts and transformers are sold separately. All AC meters have Moving Iron Vane movements that are magnetically damped and can be used for non-sinusoidal wave forms, and where economy is essential. DC units have Annular Movements that are stable even under the most severe shock and vibration conditions.

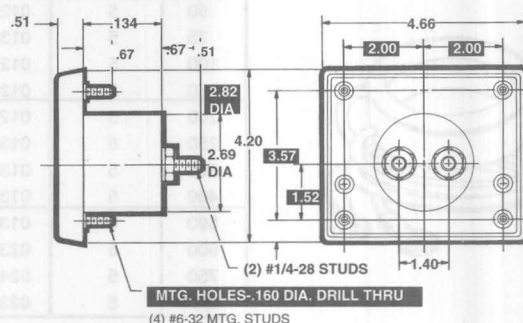
Dimensions

3-1/2"-Model 2123 & 2153

1 = Panel Meter Cut-out Dimensions



4-1/2"-Model 2124 & 2154



Specifications

Accuracy:	±2% F.S.
Movement:	Models 2153, 2154: Iron Vane, Magnetically damped Models 2123, 2124: Annular, Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum above 10 mA
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Case:	High density black phenolic.
Operating Temperature:	-4 °F to +149 °F (-20 °C to +65 °C)
Pointer:	Knife edge, with black matte finish.
Scale Length:	Models 2123, 2153: 2.75" (69.8mm) Models 2124, 2154: 4.09" (103.9mm)
Net Weight:	Model 2123: 8 oz (0.23kg) Model 2124: 11 oz (0.31kg) Model 2153: 6 oz (0.17kg) Model 2154: 9 oz (0.26 kg)
NOTE:	Meters meet ANSI specification C-39.1

Ordering Information

Percent Motor Load Panel Meters

Type	Rating	Model/Size and Catalog Number			
		3-1/2" Model #	Catalog #	4 1/2" Model #	Catalog #
DC (Note 1)	30 mV	2123	17564	2124	17637
AC (Note 2)	5 amps	2153	17711	2154	17756

Note 1: DC load meters require an external shunt and an 8 to 10 Ω , 2 watt wire-wound potentiometer (customer supplied). The appropriate shunt should be selected from accessory section and ordered separately. To select the proper shunt, first obtain the full-load current rating of your motor from the name plate, manufacturer's specifications of N.E.C. listing. Multiply that rating by 1.25 and select and order the shunt with an "amps" rating as large or slightly larger than the calculated value.

Note 2: AC load meters must be used with external donut transformers listed below.

If assistance in selecting the appropriate transformer and determining the correct primary/secondary turns ratio is required, contact a Simpson technical service representative or authorized service center by calling (708) 697-2260.

Function Reference Table

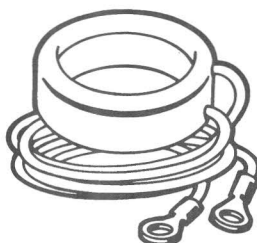
For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
DC Voltage	C	105-106
DC Current	C	75-76
AC Voltage	C	43-44
AC Current	C	17-18
Decibels	C	131-132
VU	C	171-172
RF Current	C	161-162
Watts	C	182-183

Accessories

AC Motors

Donut Transformer

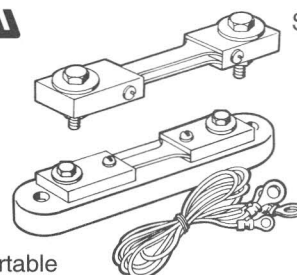


Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

A Donut Current Transformer enables this meter to monitor motors with current ratings up to 1000 amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

External Portable and Switchboard Shunts



Switchboard

These shunts are adjusted for a 50 millivolt drop for use with switchboard and panel current meters where external shunts are required. Portable shunts have a phenolic base and accept up to 200 amperes. Accuracy $\pm 1\%$, 5' leads (0.065 Ω resistance) included.

Portable Shunts 50 mV

Amps	Cat.Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts 100 mV

Amps	Cat.Number
10	06716
100	06717

NOTE: 5' leads not included

Switchboard Shunts 50 mV

Amps	Cat.Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508

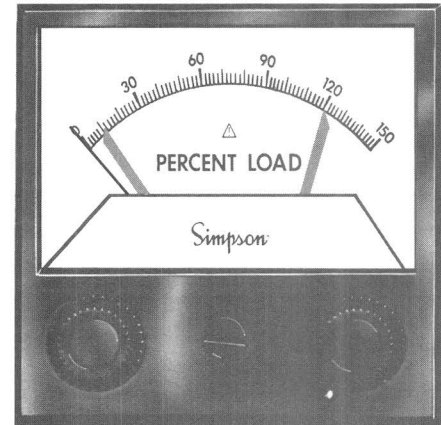
Engineers Notes



Percent Motor Load

Rugged Seal Controller

- **Rugged Metal Case for Rigorous Environments**
- **O-Ring Sealed Zero Adjust and Electrical Termination**
- **Provides Visual Monitoring of Load Conditions of AC Current Motors**
- **Single or Double Setpoints**
- **Commercially Sealed Moisture and Dust Proof**
- **Built-in Adjustable Time Delay (Delays up to 20 Seconds Available on Special Order)**



Model Number	Size	Meter Movement
3344AIXA	4-1/2"	Annular-Rectifier

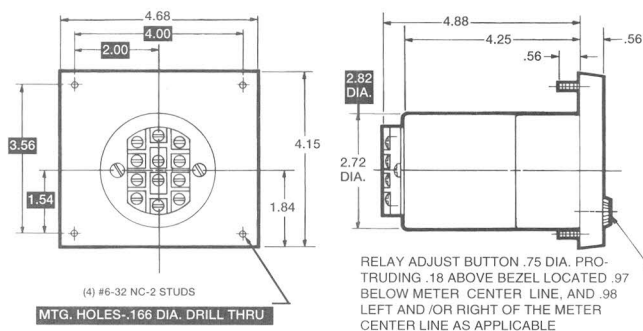
C 156 The Simpson Motor Load Meter Relay has been designed to provide visual monitoring of motor load current, in addition to the control action at one or two setpoints. The controller measures the AC current of a motor and indicates the value on a 0-150% dial. The 100% point is adjusted by means of a gain adjust potentiometer on the rear terminal block, to agree with the 100% nominal rated load current for the motor. To prevent motor shut down during start up or momentary transients where the motor current exceeds the established setpoint, a time delay of 5 seconds is provided. Delays of less than 5 seconds may be programmed using external resistors. Delays up to 20 seconds are available on special order. Specifically designed for

harsh environments, the Model 3344AIXA is housed in a metal case that gives complete magnetic isolation for steel panel mounting. The commercially sealed 33 Series meter is moisture and dust proof and recommended for use in wash down areas. The combined features of time delay, gain adjust, and auto/manual reset provide complete relay switching for alarm, motor shut down or other corrective action.

Dimensions

4-1/2" - Model 3344AIXA

1 = Panel Meter Cut-out Dimensions



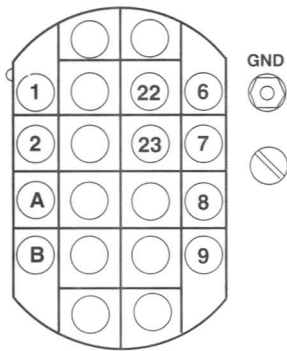
Specifications

Accuracy: $\pm 3\%$ of full scale.
Movement: Annular-Rectifier, Self-Shielding
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Repeatability: Within 0.5% F.S.
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum above 10mA
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: Sealed metal, plastic window.
Resistance: $\pm 15\%$
Pointer: Black. Knife-Edge
Scale Length: 4.05" (103.0mm)
Net Weight: 17 ozs (0.48kg)

Control Point(s) Adjustments: Single, high limit, 0-100% of arc; double, low limit 0-95% arc; high limit 5-100% of arc. Adjustable to within 4° of each other.
Switching: Within 1% of indication.
Differential: "On", "Off" difference is within 0.5% of F.S.
Auto/Manual Reset: Latching function can be enabled independently for each relay by removing jumpers on terminal block. Single Setpoint--One DPDT relay for Hi setpoint. Double Setpoint--SPDT relay for Lo setpoint DPDT relay for Hi setpoint. Each set of contacts rated at 5 amps, 115 VAC.
Contacts/Output Relay:
Frequency Response: 50-1000 Hz.
Power: 108-132 VAC, 50-400 Hz.
Operating Temperature: 41°F to 122°F ($+5^\circ\text{C}$ to $+50^\circ\text{C}$)
Circuit-to-Ground Voltage: 250V ms maximum.

Wiring Diagram

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- A. + SIGNAL INPUT
- B. - SIGNAL OUTPUT
- 1. AUTO/MAN. RESET HI SET POINT
- 2. SHORT FOR AUTO
- 6. AUTO/MAN. RESET LO SET POINT
- 7. SHORT FOR AUTO
- 8. 120 VAC $\pm 10\%$ 50-400 Hz
- 9. 5 VA
- 22. GAIN ADJUST
- 23. TO DISABLE DELAY

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Input Signal: Input to be monitored (proportional to load current) is connected to terminals A(+) and B (-). For single setpoint units, full scale can be from 0.5A RMS to 5A RMS. For dual setpoint units, full scale can be from 1 volt RMS to 10 volts RMS.

Input Power: The power source used is 120VAC $\pm 10\%$, 50 to 400 Hz. The power requirement is nominally 5VA. Connect power source to terminals 8 and 9.

Auto/Manual Reset

There are two modes of relay logic available in the 3344AIXA: Automatic Reset and Manual Reset. Auto Reset is actually a simple on-off action in which the high setpoint relay is de-energized when the pointer exceeds the high setpoint, and is automatically energized when the pointer again drops below the setpoint. The low setpoint relay is de-energized when the pointer drops below the low setpoint, and is automatically energized again when the pointer rises above the low setpoint.

Manual Reset is a latching action. When the pointer exceeds the high setpoint, the high setpoint relay energizes and is latched out. It can only pull in after the pointer drops below the high setpoint and the operator presses a reset button. In the manual reset mode the low setpoint relay is likewise latched out until the pointer is above the low setpoint and the operator presses a reset button.

Installing Auto/Manual Reset

If Auto Reset is desired, simply connect a jumper between terminals 1 and 2 for the high setpoint or 6 and 7 for the low setpoint.

If Manual Reset is desired, connect a normally-open SPST push-button switch to the terminals as shown in the terminal designation diagram to the left.

On a dual setpoint unit, the Auto or Manual mode may be selected for either setpoint independent of the mode used for the other setpoint. If both setpoints of a dual setpoint unit are connected for Manual Reset, two independent push buttons are usually used. However, one master reset button may be used for both setpoints provided it is a double pole switch with no electrical connection between poles.

Time Delay

When the meter pointer of the 3344AIXA goes upward past the high setpoint, there is a time delay before the relay contacts transfer. If the pointer returns below the high setpoint before the time delay is over, nothing happens. This prevents normal starting surges or brief transients from causing undesired operation of the relay. Please note that there is no time delay on the low setpoint.

If a longer delay is desired, a delay of 20 seconds is available on special request when ordering the 3344AIXA. Before using an extended delay, make sure that it will not present any hazard in your application.

The normal 5-second delay may be shortened by connecting a resistor or a jumper wire between terminals 22 and 23. Use the values shown in the following table.

Desired Delay (seconds)	Resistor Value
0	Jumper
0.5	39K Ω Resistor
1	100K Ω Resistor
2	300K Ω Resistor
3	620K Ω Resistor
4	1.5M Ω Resistor
5	No Connection

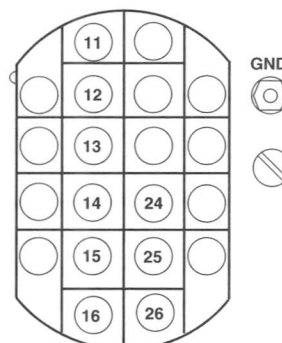
Relays

Relays can be used to "turn on" or "turn off" power to a process that the 3343AIXA and 3344AIXA are monitoring. A light can be "turned on" when a setpoint is exceeded, alerting the operator to change in condition in the process. The controller's relays are double pole, double throw for high setpoint and single pole, double throw for low setpoint.

High Setpoint: The high setpoint relay contacts (on both single and dual setpoint meters) are de-energized when the pointer is above the desired setpoint. For normally open relay connection use terminals 11 and 14. Terminals 12 and 15 are moving contacts. Terminals 13 and 16 are normally closed.

Low Setpoint Connection: The low setpoint relay contacts (appear on dual setpoint meters only) are de-energized when the pointer is below desired setpoint. For normally open relay connection use terminal 24. Terminal 25 is the moving contact or common. Use terminal 26 for normally closed relay connection.

REAR VIEW OF HEADER



TERMINAL DESIGNATIONS

- 11. NO HIGH SETPOINT.
- 12. C RELAY IS
- 13. NC DE - ENERGIZED
- 14. NO WITH POWER POINTER
- 15. C ABOVE SETPOINT.
- 16. NC
- 24. NO LOW SETPOINT.
- 25. C RELAY IS
- 26. NC DE - ENERGIZED
- WITH POWER POINTER
- BELOW SETPOINT.

RATED CIRCUIT TO GROUND VOLTAGE: 250V AC RMS MAX.
ALL RELAY CONTACT POSITIONS SHOWN WITH RELAYS DE-ENERGIZED

Adjustments

Setpoint Adjustment

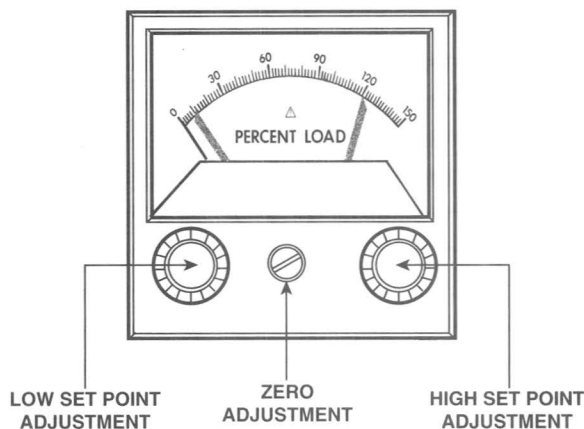
Low and High Setpoint — To adjust dual setpoint units for low range, turn the adjustment knob at the left on the front face of the meter until the wide red pointer indicates the desired reading (low from 0-95% of arc). High range adjustments are made by turning the black knob at the right on the front face of the meter (Hi from 5-100% of arc).

Zero Adjustment

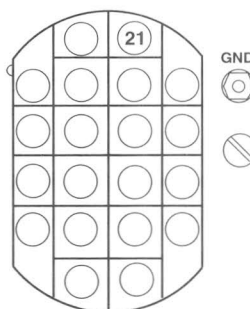
Make sure that all power to the meter has been shut down. For zero adjustment, simply turn the slotted adjustment knob which is flush with the front panel. After zeroing the pointer, turn the knob back a few degrees in the direction opposite from your final adjustment. This frees the zero adjust from the pointer mechanism.

Gain Adjustment

Make certain no power is present at the terminals of the 3344AIXA before starting. Set the high setpoint to full scale (150% mark). Remove the small plastic plug at position 21 of the terminal block. Using a nonconductive tool such as the plastic tool supplied with meter, insert the tool into the hole in the terminal block and engage the adjustment screw. Turn the adjustment screw counterclockwise 15 full revolutions. Next, apply power to the meter and to the motor circuit and operate the motor under its full normal load. While the motor is under load, turn the adjustment screw in the terminal block clockwise until the pointer indicates exactly 100%. Finally, shut down all power to the terminals of the meter and replace the small plastic plug in the terminal block.



REAR VIEW OF HEADER



TERMINAL DESIGNATION
21. GAIN ADJUST

Ordering Information

Rugged Seal 33 Series Model 3344AIXA

Scale	Range F.S.	Catalog Number Single Setpoint (High Limit)	Catalog Number Double Setpoint
0-150%*	10 VAC	21684	21644
0-150%**	5 amp AC	21683	21643

* Use with Model 186 current transformers — see below.

** Use with donut-type current transformers — see below.

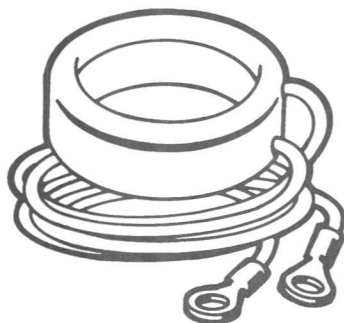
Function Reference Table

For your convenience, the table below lists Rugged seal models for other electrical monitoring functions and page reference.

Function	Section	Pages
Temperature Relays	C	147-150

Accessories

Donut Transformer

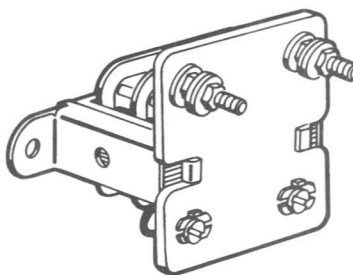


A Donut Current Transformer enables this Current Meter to monitor AC Current up to 1000 Amps. The Donut (also known as a "Toroid") is placed around one of the legs of the device being monitored, and emits up to a 5 Amp signal. Each Donut Transformer, rated at 2 Volt Amps, comes with 2' long secondary leads.

Ordering Information

Range/Amps		Catalog Number
Primary	Secondary	
50	5	01293
75	5	01306
100	5	01297
150	5	01298
200	5	01299
250	5	01313
300	5	01300
400	5	01305
500	5	01301
600	5	02303
750	5	02459
1000	5	02304

Model 186 Current Transformer



Model 186 Current Transformers easily convert a current signal (up to 50 A) into a 0-10 AC Volt signal and transmit the signal over a long distance. This allows remote monitoring of a process or application. These units can be coupled with a Donut Current Transformer if a high current rating (up to 1000 Amps) is to be monitored at a remote location.

Ordering Information

Range	VA	Catalog Number
0-1 amp	0.42	01308
0-2 amp	0.54	01309
0-3 amp	0.66	01311
0-5 amp	0.75	01312
0-10 amp	1.45	01314
0-15 amp	1.05	01315
0-20 amp	1.04	01316
0-25 amp	1.50	01317
0-30 amp	1.10	01318
0-40 amp	1.09	01319
0-50 amp	1.90	01321
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307



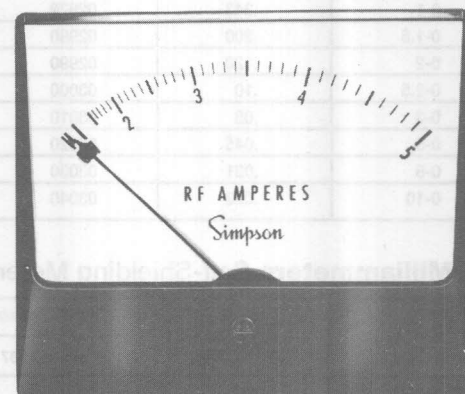
- **Wide Angle Visibility**
- **Provides Current Measurement at High Variable Frequencies (25Hz to 1MHz)**
- **High Sensitivity of 10 to 10.5 mA**
- **UL Recognized**
- **Optional Bezel and Illumination Kits**
- **Two Popular Sizes: 3-1/2" and 4-1/2"**

Simpson's Wide-Vue RF current meters offer maximum reliability and $\pm 2\%$ F.S. accuracy. Unlike the rectifier movement current meters, radio frequency meters allow current measurement at high variable frequencies (from 25 Hz to 1 MHz). The special annular movement construction utilizes a thermocouple and a permanent-magnet, moving-coil mechanism with a sensitivity of 10-10.5 milliamps DC. Choose from two sizes and various ranges from 1 to 10 RF amps and 500 RF millamps to solve your application requirements.

In addition to quality RF measurement, each meter is quality constructed with a molded black phenolic case and clear acrylic window that provides wide angle visibility and thin profile panel mounting. The Wide-Vue style

RF Ammeters

Wide-Vue Style

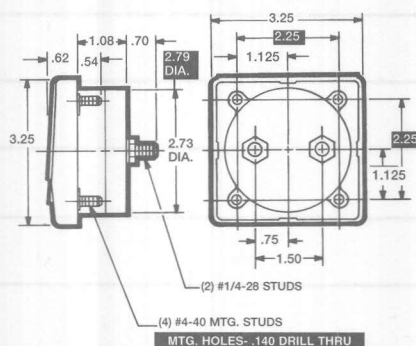


Model Number	Size	Meter Movement
1337	3-1/2"	Annular-Thermocouple
1339	4-1/2"	Annular-Thermocouple

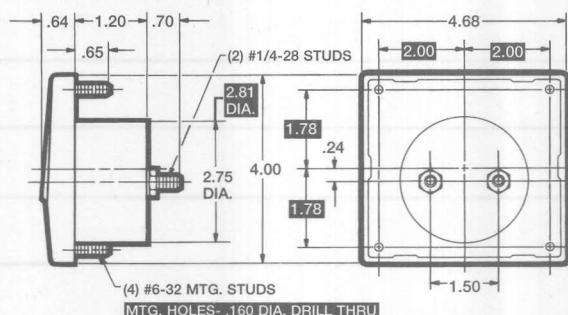
RF current meter can be surface mounted or bezel mounted (semi-flush mounted) with one of Simpson's Wide-Vue bezel kits. Whether specified for an original design or as a replacement, the Wide-Vue style meter is UL Recognized and prevents magnetic interaction between the meter and a steel panel. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Dimensions and Compatibility

3-1/2"- Model 1337



4-1/2"- Model 1339



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular-Thermocouple
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Spade, with black matte finish.
Scale Length: Model 1337: 3.14" (79.9mm)
 Model 1339: 3.39" (100mm)
Net Weight: Model 1337: 8 oz (0.23kg)
 Model 1339: 9 oz (.26kg)

Ordering Information

RF Ammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number	
		3-1/2" Model 1337	4-1/2" Model 1339
0-1	.343	02970	03050
0-1.5	.200	02980	03060
0-2	.120	02990	03070
0-2.5	.10	03000	03080
0-3	.08	03010	03090
0-5	.045	03020	03100
0-8	.031	03030	03110
0-10	.023	03040	03120

RF Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number	
		2-1/2" Model 1337	3-1/2" Model 1339
0-500	.63	05362	05364

Function Reference Table

For your convenience, the table below list Wide-Vue models for other electrical monitoring functions and page reference.

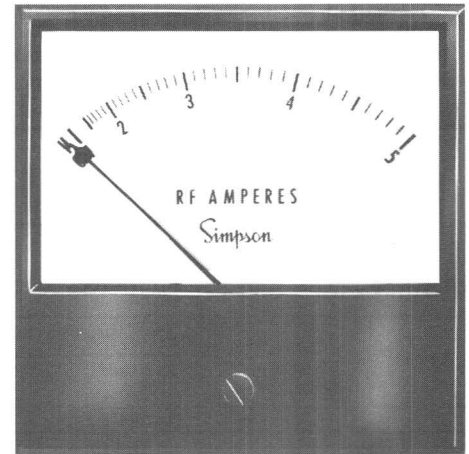
Function	Section	Pages
AC Current	C	13-14
AC Voltage	C	39-40
DC Current	C	71-72
DC Voltage	C	101-102
Decibel	C	129-130
VU	C	169-170
Watts	C	180-181

Engineers Notes



RF Ammeters

Century Style



- **±2% F.S. Accuracy**
- **Provides Current Measurement at High Variable Frequencies (25Hz to 1MHz)**
- **High Sensitivity of 10 to 10.5 mA**
- **Calibration Not Affected by Steel Panel Mounting**
- **Phenolic Cases with Glass Windows**



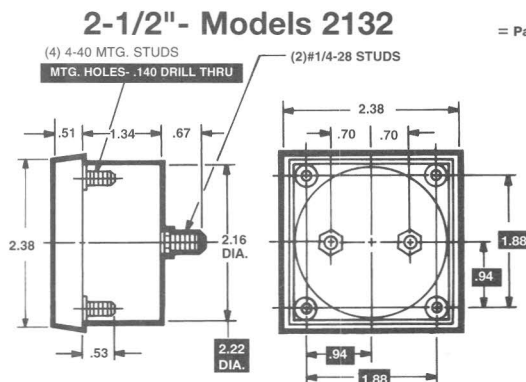
An attractive design for industrial or commercial applications, the Century offers maximum reliability and $\pm 2\%$ F.S. accuracy for all AC current measurements. Unlike the rectifier movement meters, radio frequency meters allow current measurement at high variable frequencies (from 25 Hz to 1 MHz). The special annular movement construction utilizes a thermocouple and a permanent-magnet, moving-coil mechanism with a sensitivity of 10-10.5 milliamps DC. Whether specified for an original design or as a replacement, the Century offers a self-shielding movement which is unaffected by steel panel mounting. The molded phenolic case with glass window

provides an attractive and rugged construction. Choose from three sizes and various ranges from 1 to 10 RF amps. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

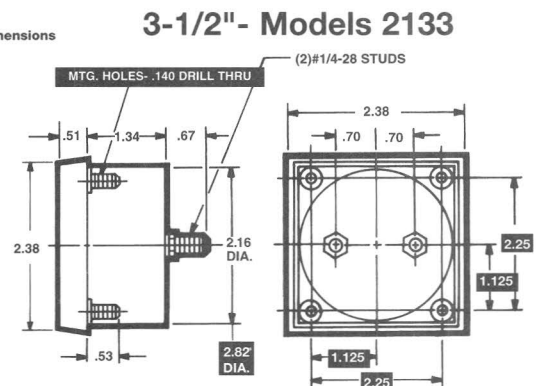
C
1
6
1

Model Number	Size	Meter Movement
2132	2-1/2"	Annular-Thermocouple
2133	3-1/2"	Annular-Thermocouple
2134	4-1/2"	Annular-Thermocouple

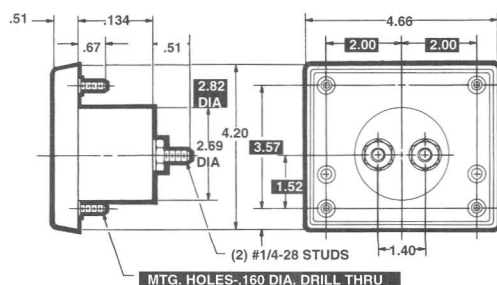
Dimensions and Compatibility



= Panel Meter Cut-out Dimensions



4-1/2" - Models 2134



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular-Thermocouple
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Knife edge, with black matte finish.
Scale Length: Model 2132: 2.07" (52.7mm)
 Model 2133: 2.75" (69.8mm)
 Model 2134: 4.09" (103.9mm)
Net Weight: Model 2132: 7 oz (0.20kg)
 Model 2133: 8 oz (.23kg)
 Model 2144: 11 oz (0.31kg)

Ordering Information

RF Ammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number		
		2-1/2" Model 2132	3-1/2" Model 2133	4-1/2" Model 2134
0-1	.343	17905	<>	17650
0-2	.120	17906	17552	17652
0-3	.08	17907	17554	<>
0-5	.045	17908	17555	<>
0-10	.023	17909	17557	17657

<> Available on special order.

Function Reference Table

For your convenience, the table below lists Century models for other electrical monitoring functions and page reference.

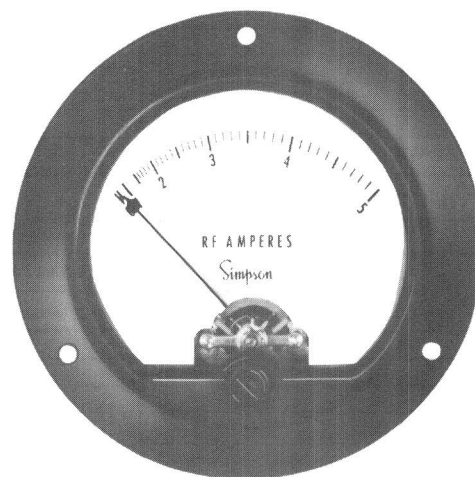
Function	Section	Pages
AC Current	C	17-18
AC Voltage	C	43-44
DC Current	C	75-76
DC Voltage	C	105-106
Decibel	C	131-132
VU	C	171-172
Watts	C	182-183



RF Ammeters

Round Style

- $\pm 2\%$ F.S. Accuracy
- Provides Current Measurement at High Variable Frequencies (25Hz to 1MHz)
- High Sensitivity of 10 to 10.5 mA
- Two Popular Sizes: 2-1/2" and 3-1/2"
- Calibration Not Affected by Steel Panel Mounting
- UL Recognized



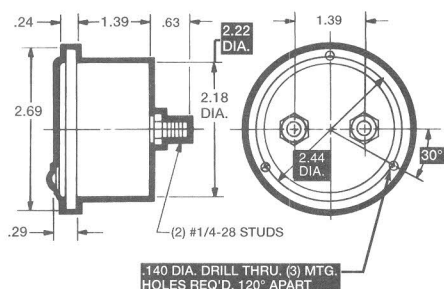
Look to the Round style RF current meter for reliable measurement of RF current from 1 to 10 RF amps and 115 to 500 RF milliamps. The round phenolic case and glass windows provide a sharp, clear appearance to your panel. Unlike the rectifier movement current meters, radio frequency meters allow current measurement at high variable frequencies (from 25 Hz to 1 MHz). The special annular movement construction utilizes a thermocouple and a permanent-magnet, moving-coil mechanism with a sensitivity of 10-10.5 milliamps DC. Whether specified for an original design or as a replacement, the Round style meter is UL Recognized and prevents magnetic interaction between the meter and a steel panel. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Model Number	Size	Meter Movement
135	2-1/2"	Annular-Thermocouple
35	2 1/2"	Annular-Thermocouple

C
1
6
3

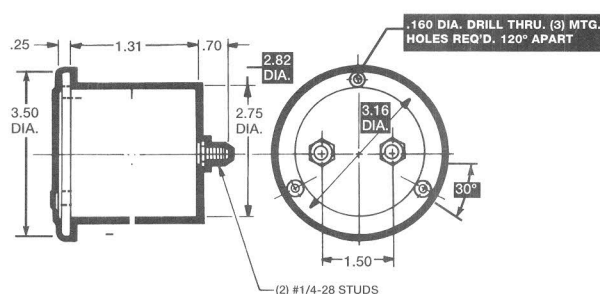
Dimensions and Compatibility

2-1/2"-Model 135



1 = Panel Meter Cut-out Dimensions

2-1/2"-Model 35



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular-Thermocouple
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Spade, with black matte finish.
Scale Length: Model 135: 1.8" (45.7mm)
 Model 35: 2.5" (63.5mm)
Net Weight: Model 135: 7 oz (0.20kg)
 Model 35: 8 oz (.23kg)

Ordering Information

RF Ammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number	
		2-1/2" Model 135	2-1/2" Model 35
0-1	.343	01901	00670
0-1.5	.200	01910	<>
0-2	.120	<>	<>
0-2.5	.10	01930	<>
0-3	.08	01940	00710
0-5	.045	01950	00720
0-8	.031	<>	<>
0-10	.023	<>	00736

RF Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number	
		2-1/2" Model 135	2-1/2" Model 35
0-115*	5.5	—	<>
0-150	4.5	—	05260
0-250	3.5	—	05270
0-500	.63	—	05280

<> Available on special order.
* 0-100 Uniformly divided scale

Function Reference Table

For your convenience, the table below lists Round models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	19-20
AC Voltage	C	45-46
DC Current	C	77-78
DC Voltage	C	107-108
Decibel	C	133-134
Watts	C	184-185

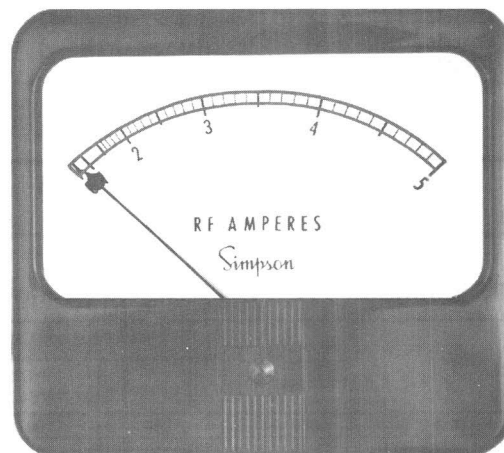
Engineers Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



RF Ammeters

Rectangular Style



- $\pm 2\%$ F.S. Accuracy
- Provides Current Measurement at High Variable Frequencies (25Hz to 1MHz)
- High Sensitivity of 10 to 10.5 mA
- Three Popular Sizes: 2-1/2", 3-1/2", & 4-1/2"
- Calibration Not Affected by Steel Panel Mounting
- UL Recognized



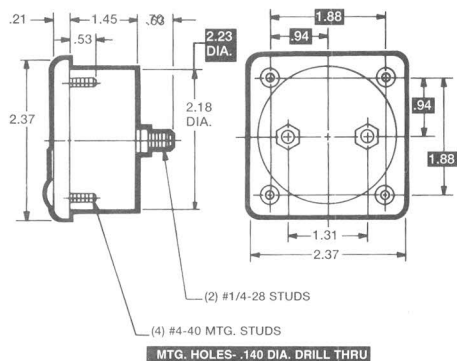
Model Number	Size	Meter Movement
137	2-1/2"	Annular-Thermocouple
37	3-1/2"	Annular-Thermocouple
39	4-1/2"	Annular-Thermocouple

For industrial or commercial applications, the Rectangular style meter offers maximum reliability and $\pm 2\%$ F.S. accuracy. Unlike the rectifier movement current meters, radio frequency meters allow current measurement at high variable frequencies (from 25 Hz to 1 MHz). The special annular movement construction utilizes a thermocouple and a permanent-magnet, moving-coil mechanism with a sensitivity of 10-10.5 milliamps DC. Whether specified for an original design or as a replacement, the Rectangular style meter is UL Recognized and prevents magnetic interaction between the meter and a steel panel. The molded phenolic case with glass window

provides an attractive and rugged construction. Choose from three sizes and various ranges from 1 to 10 RF amps and 115 to 500 RF milliamps. This style meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

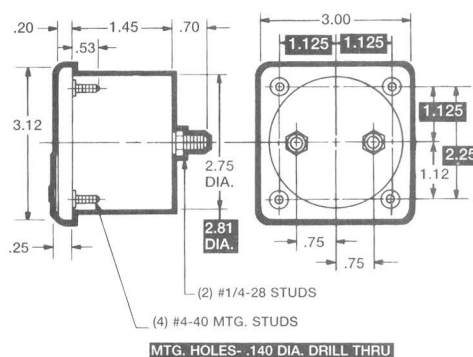
Dimensions and Compatibility

2-1/2"-Model 137

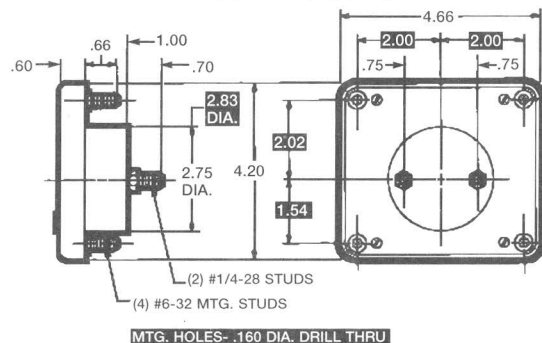


■ = Panel Meter Cut-out Dimensions

3-1/2"-Model 37



4-1/2"-Model 39



Specifications

Accuracy: $\pm 2\%$ F.S.
Movement: Annular-Thermocouple
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Spade, with black matte finish.
Scale Length: Model 137: 1.8" (45.7mm)
 Model 37: 2.5" (63.5mm)
 Model 39: 3.9" (99.0mm)
 Model 137: 7 oz (0.20kg)
 Model 37: 8 oz (.23kg)
 Model 39: 11 oz (0.31kg)

Ordering Information

RF Ammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number		
		2-1/2" Model 137	3-1/2" Model 37	4-1/2" Model 39
0-1	.343	01980	00750	00870
0-1.5	.200	02000	00770	00880
0-2	.120	02010	00780	00890
0-2.5	.10	<>	00800	00900
0-3	.08	02040	00810	00910
0-5	.045	02060	00830	00920
0-8	.031	02080	00850	00930
0-10	.023	02090	00860	00940

RF Milliammeters Self-Shielding Meter Movement

Range	Approx. Impedance (Ohms) Resistance	Model/Size and Catalog Number		
		2-1/2" Model 137	3-1/2" Model 37	4-1/2" Model 39
0-115*	5.5	—	05290	05330
0-150	4.5	—	05300	05340
0-250	3.5	—	05310	05350
0-500	.63	—	05320	05360

* 0-100 uniformly divided scale.
 <> Available on special order.

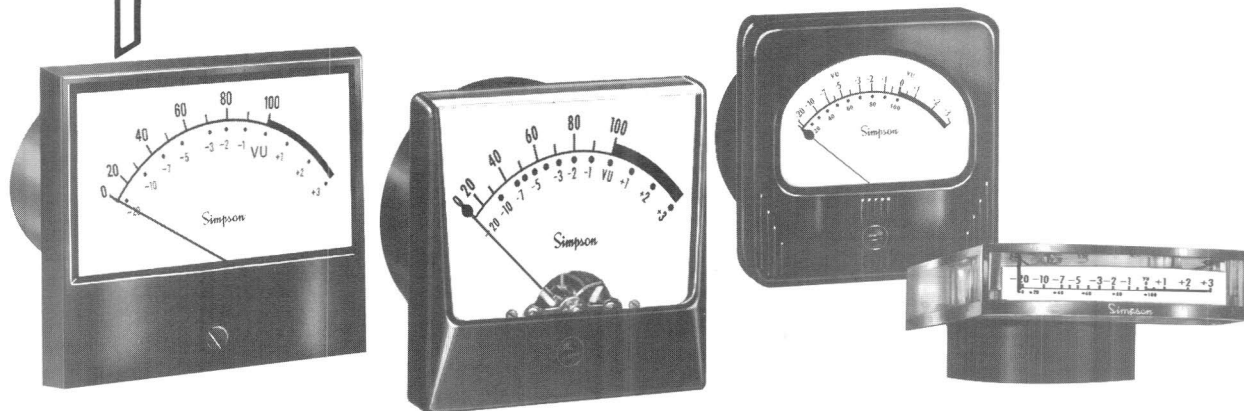
Function Reference Table

For your convenience, the table below lists Rectangular models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	21-22
AC Voltage	C	47-48
DC Current	C	79-80
DC Voltage	C	109-110
Decibel	C	135-136
VU	C	173-174
Watts	C	185-186
DC Galvanometers	C	79-80

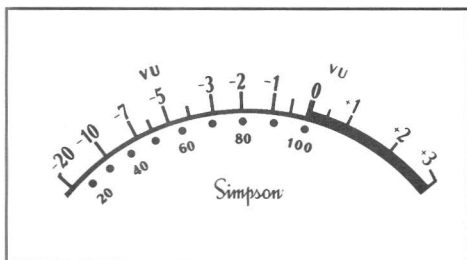
Simpson®

VU Meters

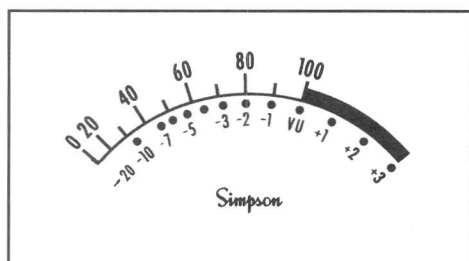


Simpson Electric manufactures a wide range of audio meters for VU measurement. They are available in 1-1/2, 2-1/2, 3-1/2 and 4-1/2 inch sizes, and Wide-Vue, Century, Round, Rectangular, Designer, and Edgewise style construction.

Simpson VU meters meet all electrical and ballistic specifications established by Bell Laboratories and American Standards Association as required by broadcasting, communication and sound engineers. VU meters conforming to military specifications are also offered. VU meters are provided with either type A or B scales as shown below.



Scale A



Scale B

The selection of the scale type will depend upon its application. For laboratory and general test work, the "A" scale is usually used to emphasize the audio level in VU over monitoring wire lines. For standard recording and broadcasting purposes, the "B" scale is used

to signify the percentage of the transmitter output. Impedance is 3900 ohms @ "0" VU deflection. Reference level: 1 mW into 600 ohms line. All VU meters have a standardized background color for the dial blank which is a buff color for easier identification.

VU as well as "dB" and "dBm" meters are all used to measure signal levels. However they are not exactly alike.

The VU and dBm meters have closely controlled ballistics and response times. This assures that the indications on transients or rapidly changing signal levels will be the same on all meters of one type (dBm or VU), even though they might vary in size or manufacture. Decibel Modulation (dBm) and VU meters also share the same reference level, 1 milliwatt in 600 ohms; dB meters do not.

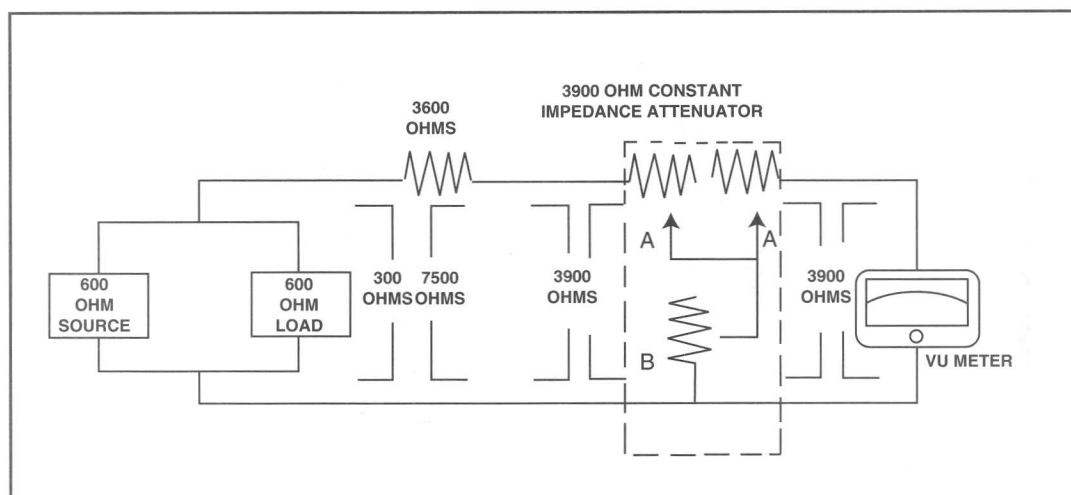
Proper VU Circuit Connection

The calibration of VU meters is based on a reference level of one milliwatt in 600 ohms. Thus a VU meter would indicate "0" VU when the voltage applied corresponds to the reference level voltage (.775 volts). However, since the meter has a somewhat lower impedance than is desirable, a series resistor (3600 ohms) is conventionally used with the meter. This resistor causes a 4 VU drop in the meter indication. Therefore, when a VU meter is connected in its normal fashion, the meter reads 4 VU lower than the actual level. The actual calibration of the meter is made with the 3600 ohm resistor in the circuit giving a total impedance of 7500 ohms when the meter reads at the "0" mark. This deflection corresponds to the +4 VU level (1.228 volts).

Although the VU meter should always be used with the 3600 ohm resistor, the meter manufacturer does not normally supply it. The VU meter is also designed to

meet specific dynamic characteristics. When the instrument is connected as shown below and energized with a sudden application of sinusoidal voltage to give a steady deflection of 0 VU, the pointer will overshoot the 0 VU mark by at least one percent but no more than 1.5%. The ballistic design also ensures

that the pointer shall deflect, when energized as above, to 99% of the 0 VU scale mark in 0.3 P/M 10% seconds. The frequency response in the instrument shall not depart from that at 1,000 Hz by more than 0.2 dB between 35 and 10,000 Hz nor more than 0.5 dB between 25 and 16,000 Hz.



ATTENUATION NETWORK FOR VOLUME LEVEL INDICATOR

Attenuator Loss—DB	Level VU*	Arm A Ohms	Arm B Ohms
0	+ 4	0	Open
1	+ 5	224.3	33801
2	+ 6	447.1	16788
3	+ 7	666.9	11070
4	+ 8	882.5	8177
5	+ 9	1093	6415
6	+10	1296	5221
7	+11	1492	4352
8	+12	1679	3690
9	+13	1857	3166
10	+14	2026	2741
11	+15	2185	2388
12	+16	2334	2091
13	+17	2473	1838
14	+18	2603	1621
15	+19	2722	1432
16	+20	2833	1268
17	+21	2935	1124
18	+22	3028	997.8
19	+23	3113	886.3
20	+24	3191	787.8
21	+25	3262	700.8
22	+26	3326	623.5
23	+27	3384	555.0

Attenuator Loss—DB	Level VU*	Arm A Ohms	Arm B Ohms
24	+28	3437	494.1
25	+29	3485	440.0
26	+30	3528	391.9
27	+31	3566	349.1
28	+32	3601	311.0
29	+33	3633	277.1
30	+34	3661	246.9
31	+35	3686	220.0
32	+36	3708	196.1
33	+37	3729	174.7
34	+38	3747	155.7
35	+39	3764	138.7
36	+40	3778	123.7
37	+41	3791	110.2
38	+42	3803	98.21
39	+43	3813	87.53
40	+44	3823	78.01
41	+45	3831	69.52
42	+46	3839	61.96
43	+47	3845	55.22
44	+48	3851	49.21
45	+49	3857	43.86
46	+50	3861	39.09

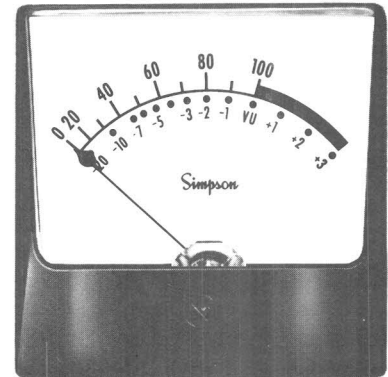
*VU—Numerically equal to number of DB above 1 mw reference level.



VU Meters

Wide-Vue Style

- Meets Bell Laboratories and ANSI Specifications
- Available in Either Type A or B Scales
- Wide Angle Visibility
- Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2"
- Phenolic Cases with Clear Acrylic Windows



Simpson's Wide-Vue style VU meters are calibrated to read zero VU or 100% with 1.228 volts applied to the meter with 3600 ohm series resistance; this represents 4 dB above 1 MW into 600 ohms. The impedance is 3900 ohms at "0" deflection. Each meter is available with either the type A or B scales. Type A scale stresses the level in VU for monitoring wire lines. Type B scale stresses percent use of transmitter output and is the standard for broadcast service.

In addition to quality VU measurement, each meter is quality constructed with a molded black phenolic case and a clear acrylic window that provides wide angle visibility and thin profile panel mounting. The Wide-Vue

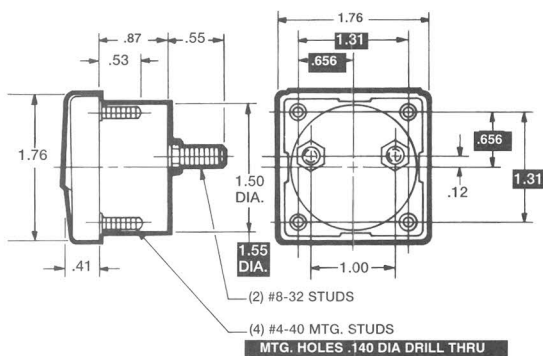
Model Number	Size	Meter Movement
1214	1-1/2"	Annular-Rectifier
1247	2-1/2"	Annular-Rectifier
1347	3-1/2"	Annular-Rectifier
1349	4-1/2"	Annular-Rectifier

style VU meter can be surface mounted or bezel mounted (semi-flush mounted) with one of Simpson's Wide-Vue bezel kits. Available in four standard sizes from 1-1/2" to 4-1/2", Simpson's VU meters can solve your application requirements. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

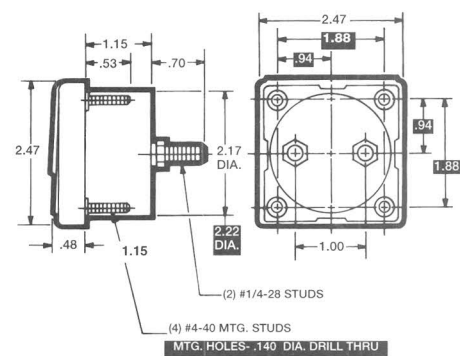
Dimensions

1 = Panel Meter Cut-out Dimensions

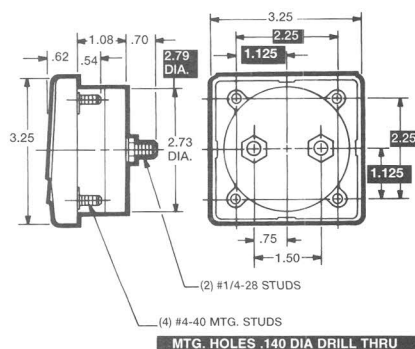
1-1/2"-Model 1214



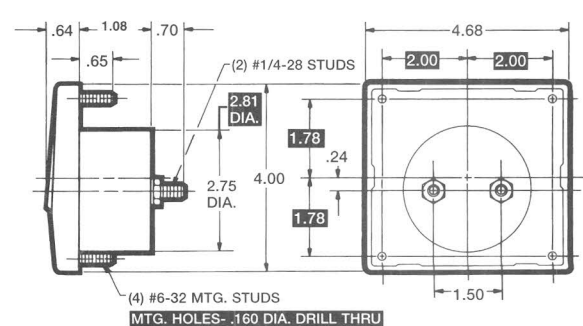
2-1/2"-Model 1247



3-1/2"-Model 1347



4-1/2"-Model 1349



VU (Volume Level) Meters Self-Shielding.
Reference Level: 1 mW into 600 Ohm Line

Scale	Model/Catalog Number			
	1-1/2" Model 1214	2-1/2" Model 1247	3-1/2" Model 1347*	4-1/2" Model 1349*
A—Scale	10472	10474	10480	10490
B—Scale	<>	<>	10550	10560

<> Available on special order.

* Illumination Kit is available.

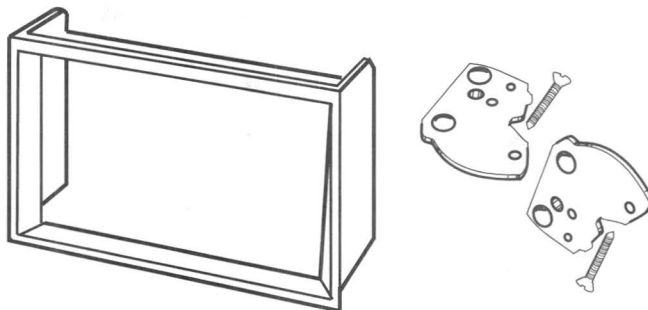
For your convenience, the table below list Wide-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	13-14
AC Current	C	39-40
DC Current	C	71-72
DC Voltage	C	101-102
Decibel	C	129-130
RF Current	C	159-160
Watts	C	180-181

Accessories**WIDE-VUE BEZEL KITS**

Behind panel bezels are available for the 3-1/2" and 4-1/2" Wide-Vue style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits may be ordered separately for use with existing meters. All mounting hardware hardware and installation instruction are included.

METER SIZE	FOR MODELS	CATALOG NO.
3-1/2"	1347	01253
4-1/2"	1349	01123





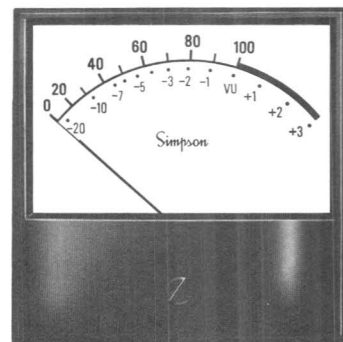
VU Meters

Century Style

- $\pm 3\%$ F.S. Accuracy
- Available in Either Type A or B Scales
- UL Recognized
- Four Popular Sizes: 1-1/2", 2-1/2", 3-1/2", 4-1/2"
- Meets Bell Laboratories and ANSI Specifications

Simpson's Century style VU meters offer an attractive design for reliable and accurate volume level measurement. They meet all specifications established by Bell Laboratories and ANSI as required by broadcasting, communication, and sound engineers and are UL Recognized. Each VU meter is calibrated to read zero VU or 100% with 1.228 volts applied to the meter with 3600 ohm series resistance; this represents 4 dB above 1 MW into 600 ohms. The impedance is 3900 ohms at "0" VU.

Simpson's VU panel meters are available with either the type A or B scales. Type A scale stresses the level in VU for monitoring wire lines. Type B scale stresses percent use of transmitter output and is the standard for broadcast service. 12 V illumination is available for 4-1/2"



Model Number	Size	Meter Movement
2141	1-1/2"	Annular-Rectifier
2142	2-1/2"	Annular-Rectifier
2143	3-1/2"	Annular-Rectifier
2144	4-1/2"	Annular-Rectifier

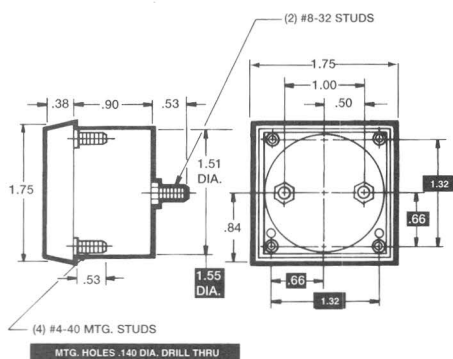
C
171

Century VU meters. Whether specified for measurement of audio frequency levels or high quality magnetic recording, the Century style VU meters represent Simpson's commitment to precision and quality. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

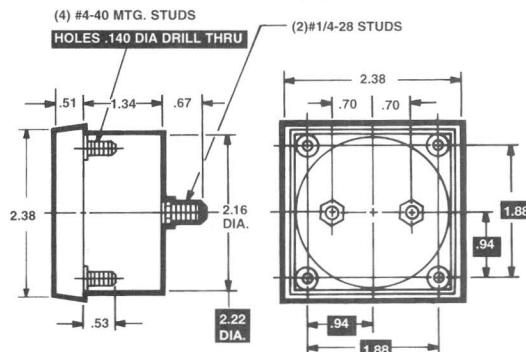
Dimensions

1-1/2"-Model 2141

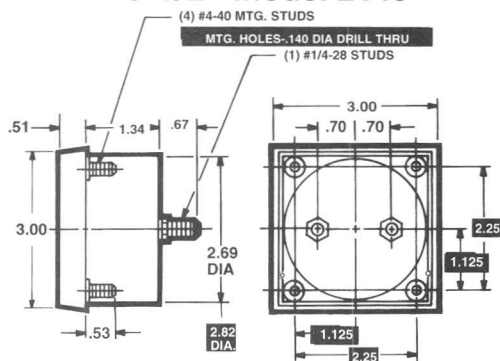
1 = Panel Meter Cut-out Dimensions



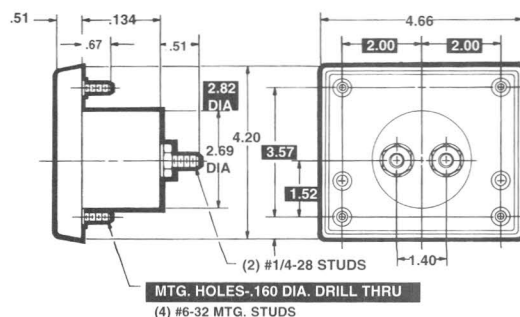
2-1/2"-Model 2142



3-1/2"-Model 2143



4-1/2"-Model 2144



Specifications

Accuracy: $\pm .25$ VU @ "0" VU
Movement: Annular-Rectifier
Suspension: Pivot and Jewel
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 0.3 seconds @ "0" VU
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Case: High density black phenolic.
Resistance: $\pm 5\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Knife edge, with black matte finish.
Scale Length: Model 2141: 1.25" (31.7mm)
 Model 2142: 2.07" (52.7mm)
 Model 2143: 2.75" (69.8mm)
 Model 2144: 3.71" (94.2mm)
Net Weight: Model 2141: 2 oz (0.06kg)
 Model 2142: 7 oz (0.20kg)
 Model 2143: 8 oz (0.23kg)
 Model 2144: 11 oz (0.31kg)

Ordering Information

VU (Volume Level) Meters Self-Shielding.
 Reference Level: 1 mW into 600 Ohm Line

Scale	Model/Catalog Number			
	1-1/2" Model 2141	2-1/2" Model 2142	3-1/2" Model 2143	4-1/2" Model 2144
A—Scale	17865	17473	17560	17646
B—Scale	<>	<>	17561	17647
A—Scale Illuminated	—	—	—	17662
B—Scale Illuminated	—	—	—	17663

<> Available on special order.
 * Two 12 V, 120 mA lamps.

Function Reference Table

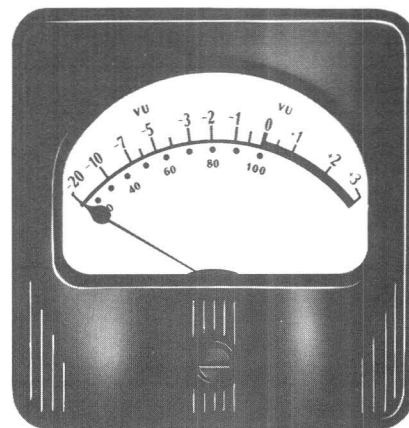
For your convenience, the table below list Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	17-18
AC Voltage	C	43-44
DC Current	C	75-76
DC Voltage	C	105-106
RF Current	C	131-132
Decibel	C	161-162
Watts	C	182-183

Engineers Notes

VU Meters

Rectangular Style



- **±2% F.S. Accuracy**
- **UL Recognized**
- **Meets Bell Laboratories and ANSI Specifications**
- **Available in Either Type A or B Scales**
- **Two Popular Sizes: 3-1/2", 4-1/2"**

Look to the Rectangular style VU meter for reliable measuring of volume level in applications such as in magnetic recording where audio frequency levels are monitored. Simpson's Rectangular style VU meters offer an attractive design for reliable and accurate volume level measurement. The meters are UL Recognized and they meet all specifications established by Bell Laboratories and ANSI as required by broadcasting communication and sound engineers. Each VU meter is calibrated to read zero VU or 100% with 1.228 volts applied to the meter with 3,600 ohms series resistance; this represents 4 dB above 1 MW into 600 ohms. The impedance is 3900 ohms at "0" VU.

Simpson's VU panel meters are available with either the type A or B scales. Type A scale stresses the level in VU



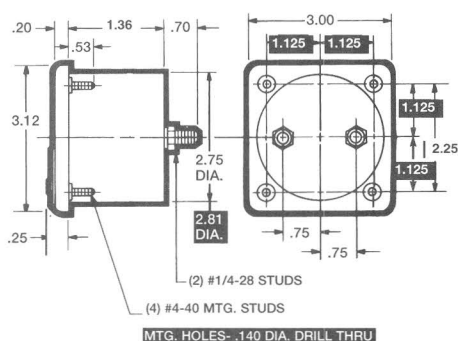
Model Number	Size	Meter Movement
47	3-1/2"	Annular-Rectifier
142	4-1/2"	Annular-Rectifier

for monitoring wire lines. Type B scale stresses percent use of transmitter output and is the standard for broadcast service. Rectangular style VU meters are offered with built in illumination. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

Dimensions

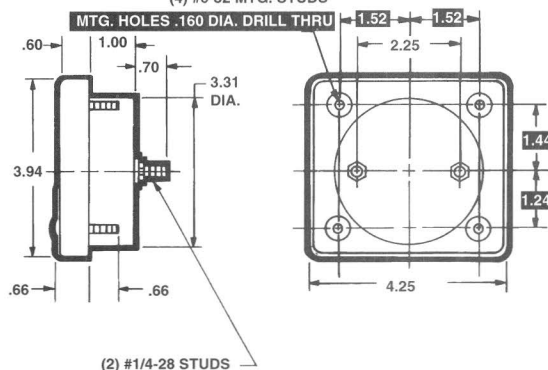
3-1/2"-Model 47

1 = Panel Meter Cut-out Dimensions



4-1/2"-Model 142

(4) #6-32 MTG. STUDS



Specifications

Accuracy:	± .25 VU @ "0" VU
Movement:	Annular-Rectifier
Suspension:	Pivot and Jewel
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	0.3 seconds @ "0" VU
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic.
Resistance:	±5%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Spade, with black matte finish.
Scale Length:	Model 47: 2.5" (63.5mm) Model 142: 3.9" (99.0mm)
Net Weight:	Model 47: 8 oz (0.23kg) Model 142: 11 oz (0.31kg)

Ordering Information

VU (Volume Level) Meters Self-Shielding.
Reference Level: 1 mW into 600 Ohm Line

±2 Bulbs, 6 V 150 mA.
<> Available on special order.

For your convenience, the table below lists Rectangular models for other electrical monitoring functions and page reference.

Engineers Notes

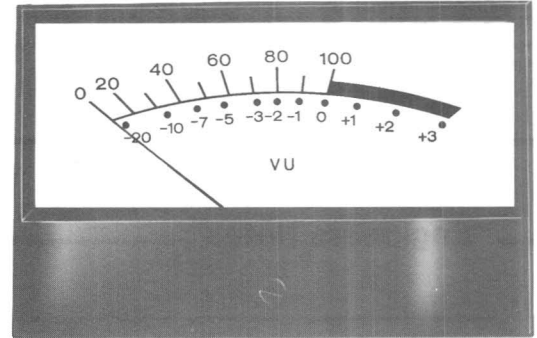
This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper appears to be a standard notebook page or a sheet of stationery. There is no handwriting or other markings on the page.



VU Meters

Designer Style

- **Clean, Uncluttered Look**
- **Meets Bell Laboratories and ANSI Specifications**
- **Available in Either Type A or B Scales**
- **Maximum Readability in Minimum Required Height**
- **Two Popular Sizes: 3-1/2", 4-1/2"**



Look to the Designer Series for a clean, uncluttered appearance and maximum readability in a minimum required height. With black phenolic case and glass window, the Designer offers a knife-edge pointer. The Designer VU meters meet all specifications established by Bell Laboratories and ANSI as required by broadcasting communication and sound engineers and are UL Recognized. Each VU meter is calibrated to read zero VU or 100% with 1.228 volts applied to the meter with 3,600 ohms series resistance; this represents 4 dB above 1 MW into 600 ohms. The impedance is 3900 ohms at "0" VU. Simpson's VU panel meters are available with either the type A or B scales. Type A scale stresses the level in VU for monitoring wire lines. Type B scale stresses percent use of transmitter output and

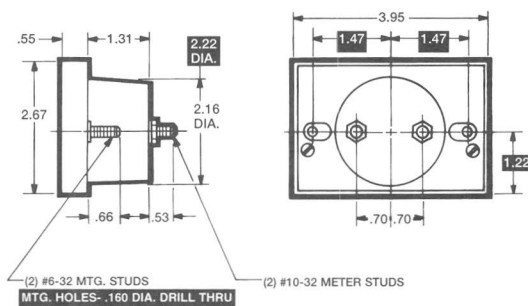
Model Number	Size	Meter Movement
543	3-1/2"	Annular-Rectifier
544	4-1/2"	Annular-Rectifier

is the standard for broadcast service. The Designer style meters can be ordered with built in illumination. Whether specified for measurement of audio frequency levels or high quality magnetic recording, the Designer style VU meters represent Simpson's commitment to precision and quality. This style of meter can be ordered for other functions as specified in the "Function Reference Table" herein.

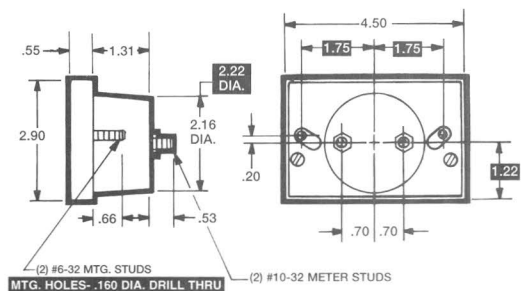
Dimensions

3-1/2" - Model 543

1 = Panel Meter Cut-out Dimensions



4-1/2" - Model 544



Specifications

Accuracy: $\pm .25$ VU @ "0" VU
Movement: Annular-Rectifier
Suspension: Pivot and Jewel
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 0.3 seconds @ "0" VU
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

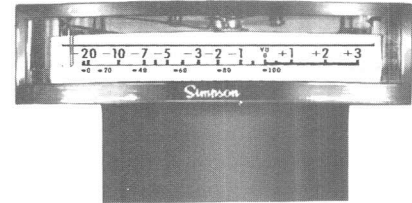
Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 1\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Black, knife edge
Scale Length: Model 543: 2.92" (74.2mm)
 Model 544: 3.25" (82.5mm)
Net Weight: Model 543: 9 oz (0.26kg)
 Model 544: 10 oz (0.14kg)



VU Meters

Edgewise Barrel

- $\pm 3\%$ F.S. Accuracy
- Compact and Light Weight
- Dustproof, Molded Acrylic Case
- Meets Bell Laboratories and ANSI Specifications
- Available in Either Type A or B Scales



Where panel meter designs call for making every square inch count or when weight saving is important, the Edgewise Barrel meters solve these design problems and many more. Its self-shielding, rectifier core magnet meter movement provides accuracy for either vertical or horizontal scale orientations with unsurpassed stability. This type of movement structure prevents magnetic interaction between meters or the mounting panel. A molded acrylic case design is dust-proof for optimum performance in less than ideal environments. The Edgewise Barrel meter is supplied with complete mounting hardware and bezel. All VU meters meet specifications established by Bell Laboratories and ANSI as required by broadcasting telecommunication and sound engineers. Each VU meter is calibrated to

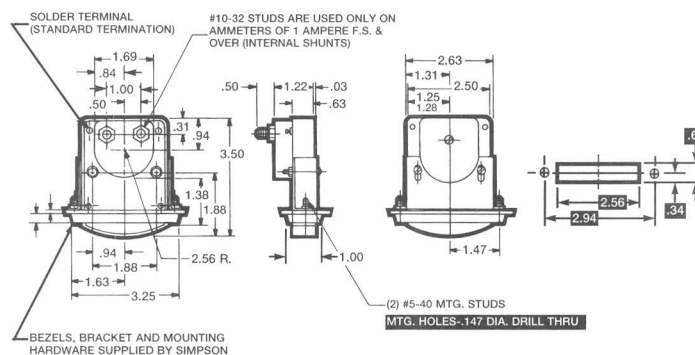
Model Number	Size	Meter Movement
1542	2-1/2"	Shallow Core Magnet Rectifier

read zero VU or 100% with 1.228 volts applied to the meter with 3,600 ohms series resistance; this represents 4 dB above 1 MW into 600 ohms. Simpson's VU panel meters are available with either the type A or B scales. Type A scale stresses the level in VU for monitoring wire lines. Type B scale stresses percent use of transmitter output and is the standard for broadcast service. This style meter can be ordered for other functions as specified in the "Function Reference Table" herein.

C
1
7
7

Dimensions

2-1/2"- Model 1542



1 = Panel Meter Cut-out Dimensions

Specifications

Accuracy: $\pm .25$ VU @ "0" VU
Movement: Shallow Core Magnet, Rectifier
Suspension: Pivot and Jewel
Shielding: Calibration is unaffected by magnetic panel mounting
Response Time: 0.3 seconds @ "0" VU
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case: High density black phenolic.
Resistance: $\pm 5\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Pointer: Lance, red.
Scale Length: Model 1542: 1.88" (47.6mm)
Net Weight: Model 1542: 4 oz (0.11kg)

Ordering Information

VU (Volume Level) Meters Self-Shielding
Reference Level: 1 mW into 600 Ohm Line.

Scale	Model/Catalog Number
	2-1/2" Model 1542
A—Scale	10500
B—Scale	10570

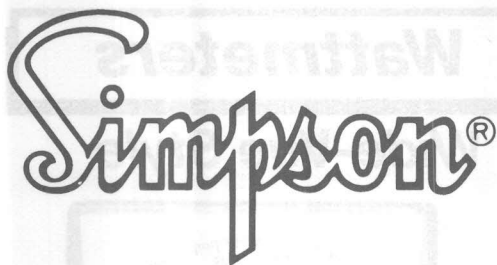
Function Reference Table

For your convenience, the table below lists Edgewise models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Voltage	C	53-54
DC Current	C	85-86
DC Voltage	C	115-116

Engineers Notes

C
1
7
8



Wattmeters



Simpson Wattmeters are available in many standard models and ranges as well as in custom applications. Choose from 2-1/2", 3-1/2" and 4-1/2" sizes. Case styles include Century, Wide-Vue, Round, and Rectangular.

Wattmeters, also termed electrodynamic instruments, depend for their operation upon the reaction between the current in the moving coils and the current in the fixed coils. In a DC circuit, the power is simply the product of the current (amperes) times the voltage; hence, it is not necessary that a separate instrument be used to determine the power consumed. In an AC circuit, however, the current and voltage may not always be in phase; that is they may not reach their maximum values at the same instant. Consequently the power is affected by the phase displacement of current and voltage, and power measurement requires an instrument which takes into consideration this phase difference. Simpson wattmeters correct for this phase difference and are the most practical means of determining true power in AC or DC circuits.

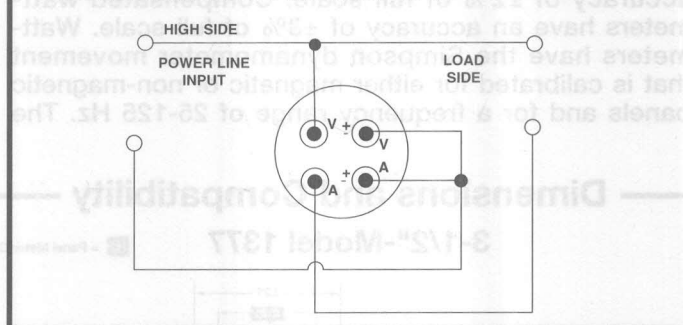
The self-contained wattmeters produced by Simpson share the desirable ability of other quality wattmeters — ± 2 F.S. accuracy on DC and a wide frequency range on the AC — less than 2% change in indication from 25 through 400 Hz. Simpson's standard wattmeter is unsuitable for use at low values of power because the power dissipated in the meter itself becomes an appreciable portion of the meter reading. This error is corrected in Simpson's compensated wattmeters.

Simpson's dynamometer type instrument contains an air-damped movement that utilizes the same high quality pivots and jewels as the other fine Simpson meters to support the moving element. The unusual shape produces an essentially linear wattage scale and reduces the overall size of the movement. Thus, Simpson can produce a wattmeter as small as 2-1/2".

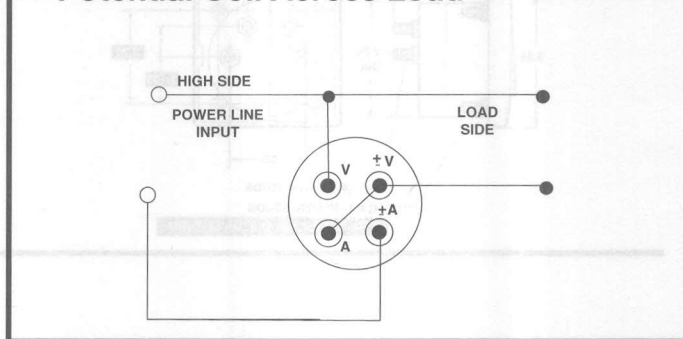
The Wide-Vue features modern styling with a durable, open-faced plastic cover for wide-angle readability

and protection of the meter face. Round, Rectangular, and Century offer easy reading, attractive design and choice of case styles.

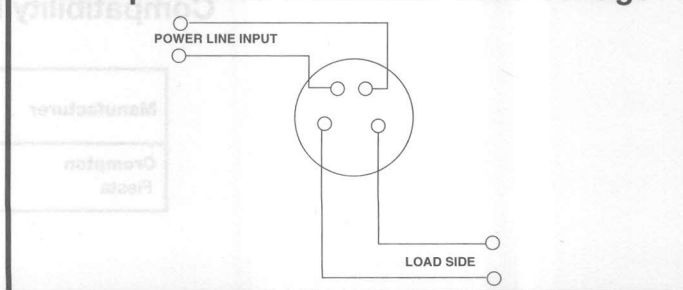
Potential Coil Across Line



Potential Coil Across Load



Compensated Wattmeter-Load Voltage



Compensated Wattmeters for Low Value Power Measurement

Dial Illumination and Bezel Kits Available



Molded in a black phenolic case, this distinctive style meter with clear acrylic window provides wide angle visibility and thin profile panel mounting. Available in 3-1/2" and 4-1/2" sizes, the Wide-Vue is ideal for reliable measurement of power from 10 to 3000 watts. At low values of power, errors are usually prevalent in standard wattmeters due to power dissipation. This error is corrected in Simpson's Compensated Wattmeters. Standard wattmeters have a single phase accuracy of $\pm 2\%$ of full scale. Compensated wattmeters have an accuracy of $\pm 3\%$ of full scale. Wattmeters have the Simpson dynamometer movement that is calibrated for either magnetic or non-magnetic panels and for a frequency range of 25-125 Hz. The

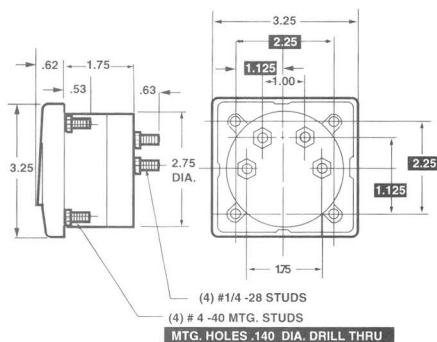
Model Number	Size	Meter Movement
1377	3-1/2"	Dynamometer
1379	4-1/2"	Dynamometer

dynamometer movement is air-damped which utilizes the same high quality pivots and jewels as the other fine Simpson meters to support the moving element. This style of meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

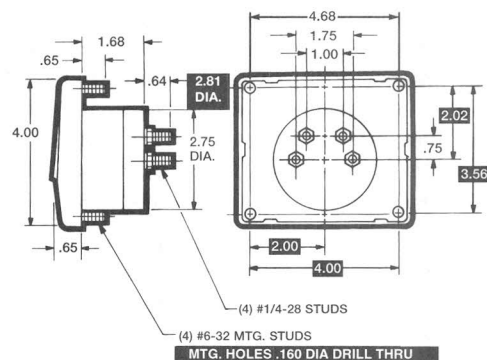
Dimensions and Compatibility

3-1/2"-Model 1377

1 = Panel Meter Cut-out Dimensions



4-1/2"-Model 1379



Compatibility Reference Table

Manufacturer	Size/Model
	31/2"
Crompton Fiesta	Model 016

Specifications

Accuracy: $\pm 2\%$ F.S; Compensated Meters: $\pm 3\%$ F.S.
Movement: Dynamometer
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: High density black plastic.
Pointer: Spade pointer with black matte finish.
Scale Length: Model 1377: 3.14" (79.9 mm)
 Model 1379: 3.93" (100.0 mm)
Net Weight: Model 1377: 9 oz (0.26 kg)
 Model 1379: 10 oz (0.28 kg)

Ordering Information

Wattmeters Dynamometer Type, Single-Phase

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps	3-1/2" Model 1377	4-1/2" Model 1379
0-75	150	1.0	<>	10960
0-150	150	2.0	<>	10970
0-300	150	4.0	<>	10975
0-600	300	4.0	<>	10980
0-750	150	10.0	<>	10990
01500	300	10.0	<>	11000
0-3000	300	20.0	<>	11010

Compensated Wattmeters* Accuracy $\pm 3\%$

The standard wattmeter is suitable for use at low values of power because the power dissipated in the meter itself becomes an appreciable portion of the meter reading. This error is corrected in a Compensated wattmeter.

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps		
0-10	150	.175	<>	10930
0-20	150	.400	<>	10940

* Wattmeters calibrated for either magnetic on non-magnetic panels and for a frequency range of 25-125 Hz.
 <> Available on special order.

Function Reference Table

For your convenience, the table below lists Wide-Vue models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	13-14
AC Voltage	C	39-40
DC Current	C	71-72
DC Voltage	C	101-102
Decibel	C	129-130
VU	C	169-170
RF Current	C	161-162
DC Galvanometers	C	71-72

Wide-Vue Bezel and Illumination Kits

Bezels are available for Wide-Vue style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits include all mounting hardware and can be ordered with meters or separately.

Illumination Kits are available for the 4-1/2" meters. The kit includes a pair of 6.3 volt bulbs, .25 amps. The bulbs are mounted above the meter, and are designed to be used with the bezel kits. The kit illuminates the meter for ease of reading in dark areas. For more Detailed Information see the accessory section.

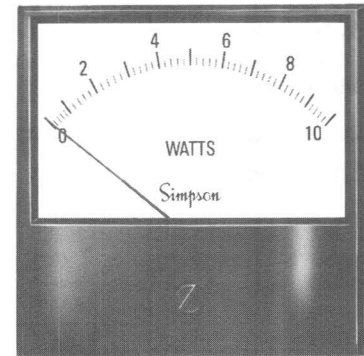
Model Number	Catalog Number
1357 (3-1/2") Bezel	01253
1359 (4-1/2") Bezel	01123
1359 Illumination Kit	01165

Engineers Notes



Wattmeters

Century Style



- Calibration for Either Magnetic or Non-Magnetic Panel Mounting
- Wide Angle Visibility
- $\pm 2\%$ F.S. Accuracy ($\pm 3\%$ F.S. for Compensated Type)
- Two Popular Sizes: 3-1/2", 4-1/2"
- Compensated Wattmeters for Low Value Power Measurement
- Phenolic Cases With Glass Windows

Model Number	Size	Meter Movement
2173	3-1/2"	Dynamometer
2174	4-1/2"	Dynamometer

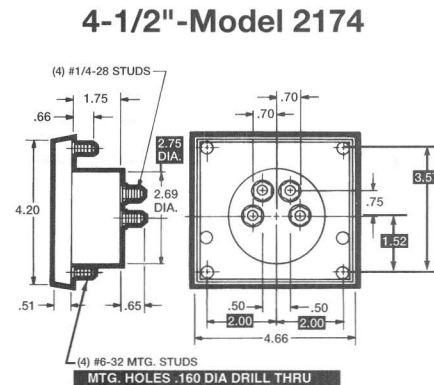
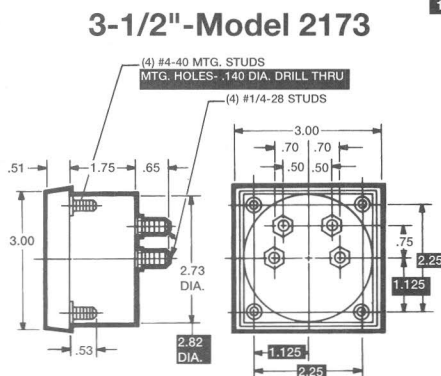
C
182

Molded in black phenolic case, the Century sports a crisp design with sharp, beveled edges and large glass window for easy viewing. Available in 3-1/2" and 4-1/2" sizes, this style can be ordered in ranges from 10 to 3000 watts. At low values of power, errors are usually prevalent in standard wattmeters due to power dissipation. This error is corrected in Simpson's Compensated Wattmeters. Standard wattmeters have a single phase accuracy of $\pm 2\%$ of full scale. Compensated wattmeters have an accuracy of $\pm 3\%$ of full scale.

Wattmeters have the Simpson dynamometer movement that is calibrated for either magnetic or non-

magnetic panels and for a frequency range of 25-125 Hz. The dynamometer movement is air-damped which utilizes the same high quality pivots and jewels as the other fine Simpson meters to support the moving element. This style of meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.

Dimensions and Compatibility



Compatibility Reference Table

Manufacturer	Size/Model
	31/2"
Crompton Fiesta	Model 016

Specifications

Accuracy: $\pm 2\%$ F.S; Compensated Meters: $\pm 3\%$ F.S.
Movement: Dynamometer
Suspension: Pivot and Jewel
Tracking: $\pm 3\%$
Shielding: Calibration is unaffected by magnetic panel mounting.
Response Time: 1.5 seconds maximum
Overload (1 sec.): 10 times full scale rating
Overload (Continuous): 1.5 times full scale rating
Repeatability: 2%

Dial: Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance: $\pm 15\%$
Operating Temperature: -4°F to $+149^{\circ}\text{F}$ (-20°C to $+65^{\circ}\text{C}$)
Case: High density black phenolic.
Pointer: Knife edge, with black matte finish.
Scale Length: Model 2173: 2.48" (63.0 mm)
 Model 2174: 3.68" (93.5 mm)
Net Weight: Model 2173: 9 oz (0.26 kg)
 Model 2174: 13 oz (0.37 kg)

Ordering Information

Wattmeters Dynamometer Type, Single-Phase

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps	3-1/2" Model 2173	4-1/2" Model 2174
0-75	150	1.0	17881	17896
0-150	150	2.0	17882	17897
0-300	150	4.0	17883	17898
0-600	300	4.0	17884	17899
0-750	150	10.0	17885	17900
0-1500	300	10.0	17886	17901
0-3000	300	20.0	17887	17902

Compensated Wattmeters* Accuracy $\pm 3\%$

The standard wattmeter is suitable for use at low values of power because the power dissipated in the meter itself becomes an appreciable portion of the meter reading. This error is corrected in a Compensated wattmeter.

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps	3-1/2" Model 2173	4-1/2" Model 2174
0-10	150	0.175	17875	17890
0-20	150	0.400	17876	17891
0-30	150	0.650	17877	17892
0-30	300	0.300	17879	17894
0-50	300	0.500	17880	17895

* Wattmeters calibrated for either magnetic on non-magnetic panels and for a frequency range of 25-125 Hz.
 <> Available on special order.

Function Reference Table

For your convenience, the table below list Century models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	17-18
AC Voltage	C	43-44
DC Current	C	75-76
DC Voltage	C	105-106
Decibel	C	131-132
RF Current	C	161-162
VU	C	171-172
DC Galvanometers	C	75-76

Engineers Notes

Specifications

Accuracy:	±2% F.S; Compensated Meters: ±3% F.S.
Movement:	Dynamometer
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%

Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 175: 1.60" (40.60 mm) Model 75: 2.30" (58.40 mm)
Net Weight:	Model 175: 9 oz (0.26 kg) Model 75: 9 oz (0.26 kg)

Ordering Information

Wattmeters Dynamometer Type, Single-Phase

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps	2-1/2" Model 175	3-1/2" Model 75
0-75	150	1.0	<>	<>
0-150	150	2.0	<>	<>
0-300	150	4.0	<>	10600
0-600	300	4.0	<>	<>
0-750	150	10.0	<>	<>
0-1500	300	10.0	<>	<>
0-3000	300	20.0	<>	<>

Compensated Wattmeters* Accuracy ±3%

The standard wattmeter is suitable for use at low values of power because the power dissipated in the meter itself becomes an appreciable portion of the meter reading. This error is corrected in a Compensated wattmeter.

Range	Maximum		Model/Size and Catalog Number	
	Volts	Amps		
0-20	150	.400	-	<>

* Wattmeters calibrated for either magnetic or non-magnetic panels and for a frequency range of 25-125 Hz.
<> Available on special order.

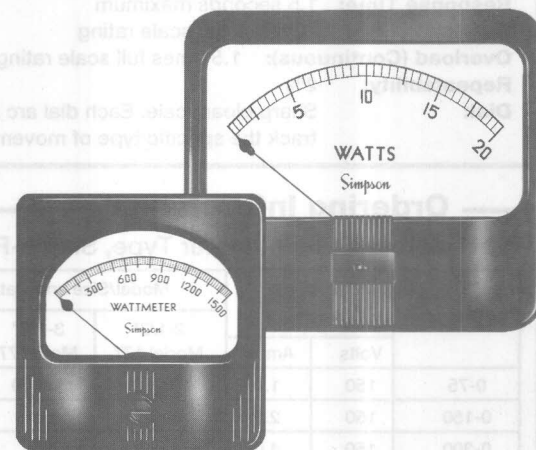
Function Reference Table

For your convenience, the table below lists Round models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	19-20
AC Voltage	C	45-46
DC Current	C	77-78
DC Voltage	C	107-108
Decibel	C	133-134
RF Current	C	163-164
DC Galvanometers	C	77-78

Wattmeters

Rectangular Style



Model Number	Size	Meter Movement
177	2-1/2"	Dynamometer
77	3-1/2"	Dynamometer
79	4-1/2"	Dynamometer

Compensated Wattmeters for Low Value Power Measurement

±2% F.S. Accuracy (±3% F.S. for Compensated Type)

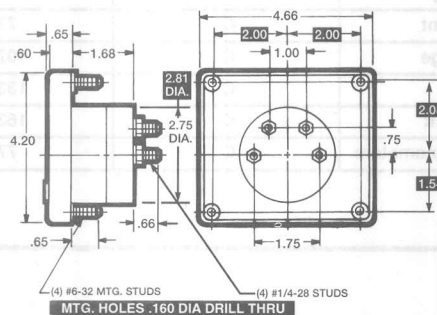
Calibration for Either Magnetic or Non-Magnetic Panels

Three Popular Sizes: 2-1/2", 3-1/2", 4-1/2"

Phenolic Cases With Glass Windows

For unsurpassed stability and quality performance look to Simpson's rectangular style meters. The rectangular style offers an attractive look with sharp, beveled edges and glass windows for easy viewing. Available in 2-1/2", 3-1/2" and 4-1/2" sizes (3-1/2", 4-1/2" sizes only for Compensated type), this style can be ordered in ranges from 20 to 3000 watts. At low values of power, errors are usually prevalent in standard wattmeters due to power dissipation. This error is corrected in Simpson's Compensated wattmeters. Standard wattmeters have a single phase accuracy of ±2% of full scale (±3% of full scale for Compensated type). Wattmeters have the Simpson dynamometer movement that is calibrated for either magnetic or non-magnetic panels and for a frequency range of 25-125 Hz.

The dynamometer movement is air-damped which utilizes the same high quality pivots and jewels as the other fine Simpson meters to support the moving element. This style of meter is ideal for many other electrical functions as mentioned in the "Function Reference Table" herein.



Compatibility Reference Table

Manufacturer	Size/Model
	31/2"
Crompton Fiesta	Model 016

Specifications

Accuracy:	±2% F.S; Compensated Meters: ±3% F.S.
Movement:	Dynamometer
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting.
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Case:	High density black phenolic.
Pointer:	Spade Pointer, with black matte finish.
Scale Length:	Model 177: 1.60" (40.60 mm) Model 77: 2.30" (58.40 mm) Model 79: 3.50" (89.0 mm)
Net Weight:	Model 177: 9 oz (0.26 kg) Model 77: 9 oz (0.26 kg) Model 79: 12 oz (0.34 kg)

Ordering Information

Wattmeters Dynamometer Type, Single-Phase

Range	Maximum		Model/Size and Catalog Number		
	Volts	Amps	2-1/2" Model 177	3-1/2" Model 77	4-1/2" Model 79
0-75	150	1.0	10860	10650	10720
0-150	150	2.0	<>	<>	10730
0-300	150	4.0	<>	<>	10740
0-600	300	4.0	<>	10680	10750
0-750	150	10.0	10900	10690	10760
0-1500	300	10.0	10910	10700	10770
0-3000	300	20.0	10920	10710	10780

Compensated Wattmeters* Accuracy ±3%

0-20	150	.400	—	<>	10714
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* Wattmeters calibrated for either magnetic on non-magnetic panels and for a frequency range of 25-125 Hz.

<> Available on special order.

Function Reference Table

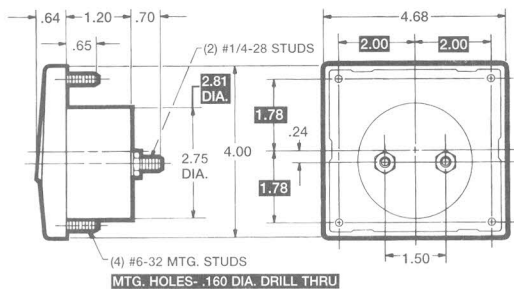
For your convenience, the table below lists Rectangular models for other electrical monitoring functions and page reference.

Function	Section	Pages
AC Current	C	21-22
AC Voltage	C	47-48
DC Current	C	79-80
DC Voltage	C	109-110
Decibel	C	135-136
RF Current	C	165-166
VU	C	173-174
DC Galvanometers	C	79-80

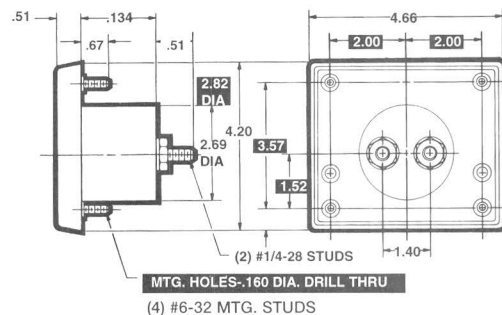
Dimensions

1 = Panel Meter Cut-out Dimensions

4-1/2"-Model 1329 - Wide-Vue



4-1/2"-Model 2124 - Century



Specifications

Accuracy:	±2% F.S.
Movement:	Model 3623: Shallow Core Magnet All Other Models: Annular, Self-shielding
Suspension:	Pivot and Jewel
Tracking:	±3%
Shielding:	Calibration is unaffected by magnetic panel mounting
Response Time:	1.5 seconds maximum
Overload (1 sec.):	10 times full scale rating
Overload (Continuous):	1.5 times full scale rating
Repeatability:	2%
Dial:	Sharp clear scale. Each dial arc is calibrated to track the specific type of movement used.
Case:	High density black phenolic. Model 3623: Diecast with phenolic inserts.

Resistance:	±15%
Operating Temperature:	-4°F to +149°F (-20°C to +65°C)
Pointer:	Models 1327, 1329: Spade pointer, with black matte finish. Models 2123, 2124: Knife edge, with black matte finish.
Scale Length:	Model 3623: Black, lance pointer Model 1327: 3.04" (77.0mm) Model 1329: 3.82" (97mm) Model 2123: 2.75" (70mm); Model 2124: 4.09" (104mm) Model 3623: 2.60" (66mm)
Net Weight:	Models 1327, 2123: 8 oz (.23kg) Models 1329, 3623: 9 oz (.26kg) Models 2124: 11 oz (.31kg)

Ordering Information

SIZE	STYLE	MODEL	CATALOG NO.
3-1/2"	Century	2123	35027
3-1/2"	Wide-Vue	1327	35025
3-1/2"	Edgewise	3623	16869
4-1/2"	Wide-Vue	1329	35026
4-1/2"	Century	2124	35028

Function Reference Table

For your convenience, the table below lists Wide-Vue, Century, and Edgewise models for other electrical monitoring functions and page reference.

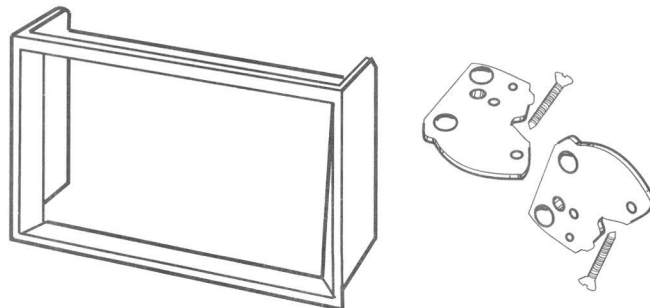
Function	Style		
	Wide-Vue	Century	Edgewise
AC Current	C13-14	C17-18	C25-26
AC Voltage	C39-40	C43-44	C51-52
DC Current	C71-72	C75-76	C83-84
DC Voltage	C101-102	C105-106	C113-114
Decibels	C129-130	C131-132	
Temperature		C144-146	
Percent Motor Load	C152-153	C154-155	
RF Current	C159-160	C161-162	
VU	C169-170	C171-172	
Watts	C180-181	C182-183	

Accessories

WIDE-VUE BEZEL KITS

Behind panel bezels are available for the 3-1/2" and 4-1/2" Wide-Vue style meters to give your equipment a modern appearance. Bezels are die cast with an attractive black satin finish and are designed for behind panel mounting on material thickness of 1/8" to 3/16". Bezel kits may be ordered separately for use with existing meters. All mounting hardware and installation instruction are included.

METER SIZE	FOR MODELS	CATALOG NO.
3-1/2"	1327	01253
4-1/2"	1329	01123





4-20 mA Process

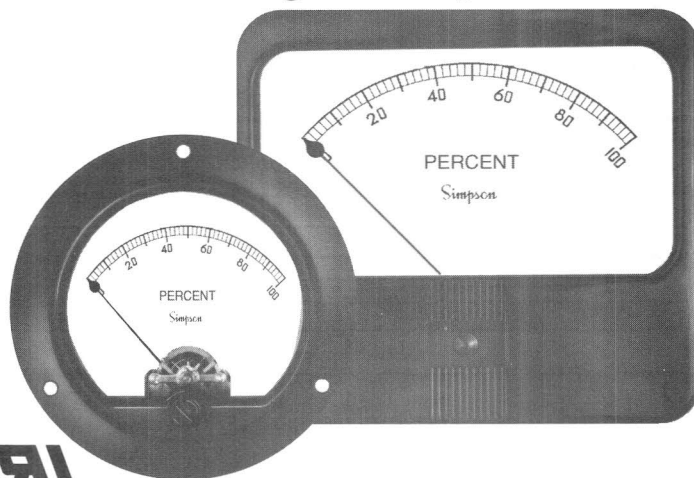
Round and Rectangular Styles

- Two Styles in Two Sizes
- Self-Shielded Meter Movements
- Rugged and Reliable
- Custom Dials
- UL Recognized
- Built to ANSI C39.1 Specifications
- $\pm 2\%$ Accuracy F.S.

Responding to your process control metering needs, Simpson has expanded its panel meter product line to include 4-20 DC mA current loop, analog meters in two of our most popular styles: Round and Rectangular.

Perfect for many process applications, such as temperature, pressure and flow, these meters all have Simpson's magnetically self-shielded meter movement, calibration unaffected by stray magnetic fields or mounting, and are rated at $\pm 2\%$ F.S. accuracy. The Round and Rectangular styles feature dials with a 0 to 100% scale.

All Simpson panel meters can be tailored to fit your special application requirements with custom dials, etc.



Model Number	Size	Meter Movement
25	3-1/2"	Annular
27	3-1/2"	Annular
29	4-1/2"	Annular

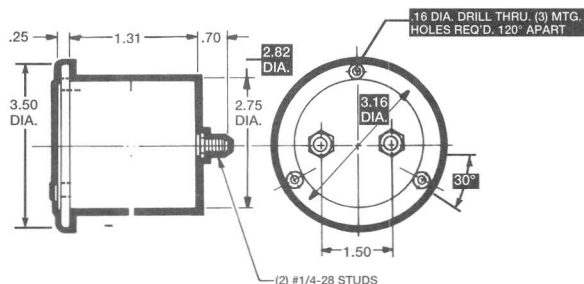
C
1
8
9

Call your authorized Simpson Service Center or the factory for your 4-20 mA meters with your custom dial requirements.

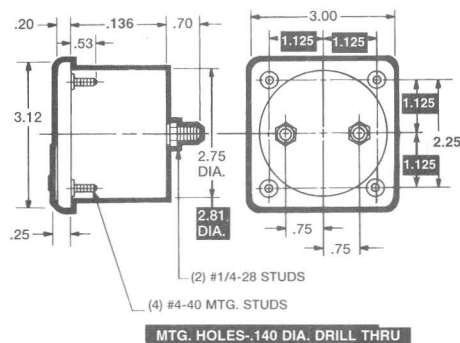
Dimensions

1 = Panel Meter Cut-out Dimensions

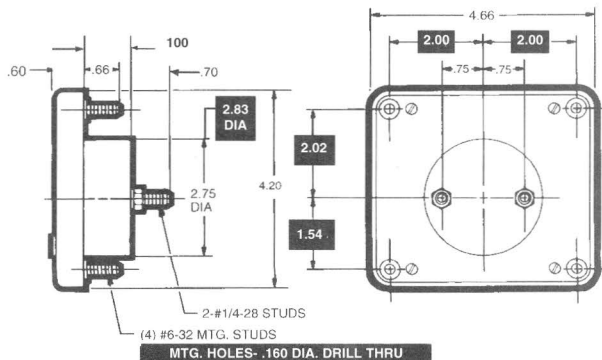
3-1/2"- Model 25 - Round



3-1/2"- Model 27 - Rectangular



4-1/2"- Model 29 - Rectangular





Custom/Special Analog Panel Indicators

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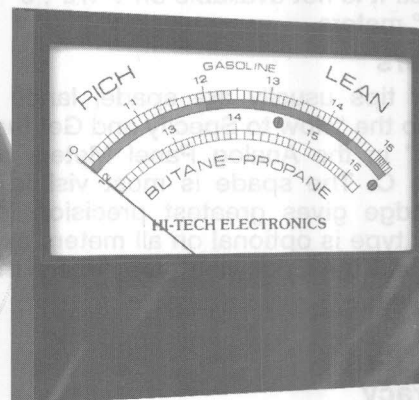
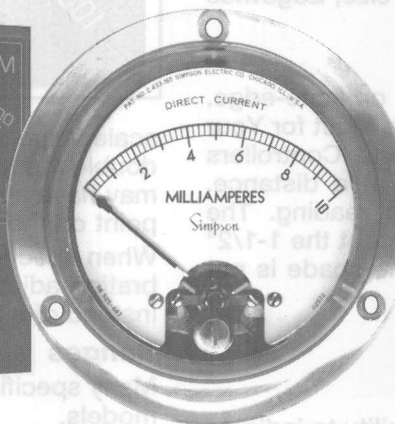
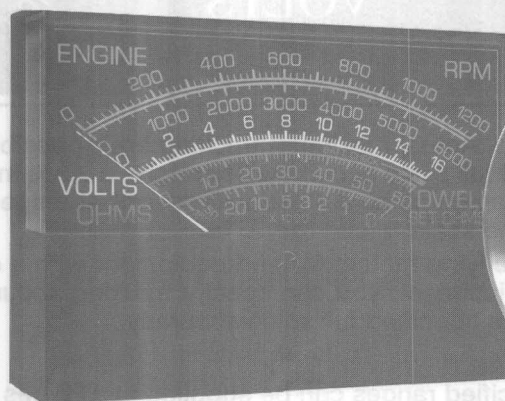
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Just Tell Us The Features You Need

Shortly after Simpson began manufacturing panel meters in 1936, requests were made for various modifications and/or special features not found in the standard product line. This continues to be a substantial part of our business, and we invite inquiries for this type of product.

Our standard product line of panel meters encompasses a variety of physical sizes and styles. Case enclosures from as small as approximately 1-1/2" through 8" are available. The case and cover material of most

meters are phenolic with a glass viewing window. One style uses a phenolic case and acrylic cover. Some are all acrylic. A few are metal cased with glass windows. Where acrylic or glass is used, lexan can be substituted on special order, at a nominal additional cost.

If none of our available case designs are acceptable for the meters you wish to order, we invite your inquiry to design, tool and manufacture an enclosure to your specifications.



Custom/Special Analog Panel Indicators

Mechanical Custom Dials

When ordering analog panel meters, you may want the dial marked to your specifications. If a logo is required, please submit a good quality reproducible copy with your order.

Frequently, the dial must be marked in units of measurement specific to the application. Please furnish data indicating scale points vs. electrical input to the meter.

Standard marked colors are black, white, red, yellow, green and blue. Other colors can be specially ordered.

Dials are printed by offset lithography using a chemically etched plate made from the original. Each color requires a separate plate. A one-time dial artwork charge for each plate may be applicable with the initial order.

Mirror Dial

When precision readings are required, a mirror is suggested. This curved segment, located near the scales, reflects the pointer and eliminates reading errors due to parallax. It is not available on 1-1/2", 8" size, Edgewise or 250° meters.

Pointers

Pointer tips usually are spade, lance or knife-edge. Refer to the "How to Specify and Get the Most for Your Money" in the Analog Panel Meters and Controllers section C. The spade is most visible at a distance. Knife-edge gives greatest precision in reading. The pointer type is optional on all meters except the 1-1/2" meter and the Edgewise type, where the spade is not available.

Electrical

Accuracy

Accuracy is the measure of a meter's ability to indicate the absolute value of electrical energy applied.

Standard accuracy tolerance of most commercial panel meters is $\pm 2\%$ of full scale. Accuracy of $\pm 1\%$ is available.

Symmetry

Symmetry (which applies only to offset zero meters) is a meter's ability to provide corresponding indications on each side of zero when polarity of applied energy is reversed. Symmetry is expressed as a percentage of full scale. Full scale is the arithmetic sum of the two end scale values. Standard symmetry is specified at $\pm 4T$.

Tracking

Tracking accuracy is the meter's ability to indicate, at the scale mark being checked, when the meter is energized by a proportional value of the actual end scale excitation. Tracking is expressed as a percentage of full

Figure 1. Zero Right

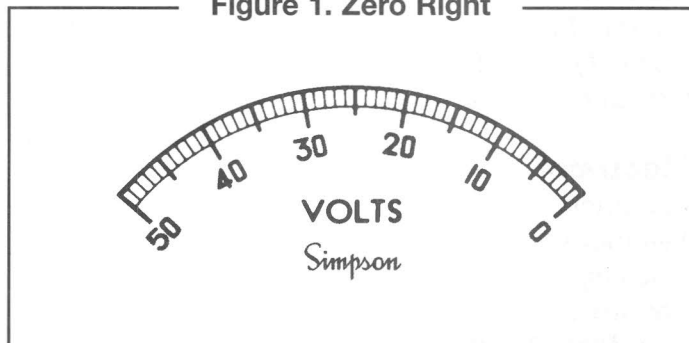
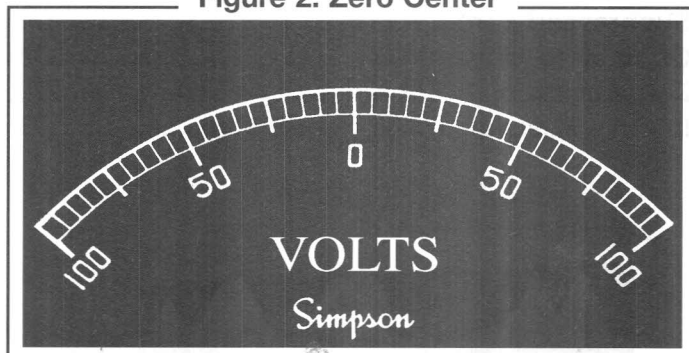


Figure 2. Zero Center



scale value. Actual maximum tracking error possible is double the full scale accuracy. Therefore, a $\pm 2\%$ meter may have as much as a 4% tracking error at a specific point on the scale.

When specifying meters for end equipment with a calibration adjustment, you can specify tracking accuracy instead of a specified full scale accuracy.

Ranges

Many specified ranges can be supplied in all types and models.

Zero Right Movement

Meters except the zero center and offset zero types have their zero indication at the left end of the scale. With some applications, having the zero position on the right end of the scale is best. Example: 50-0 instead of 0-50 (Figure 1).

Zero Center

Zero Center meters have their zero at the top center of the scale, and the meter measures equal amounts in either direction. Example: 100-0-100 (Figure 2).

Suppressed Zero

This specially made meter does not display or measure the beginning portion of the range. Instead of a typical zero, the meter's scale displays some value above zero. An example is a range of 15-40, in which 15 replaces

Figure 3. Suppressed Zero

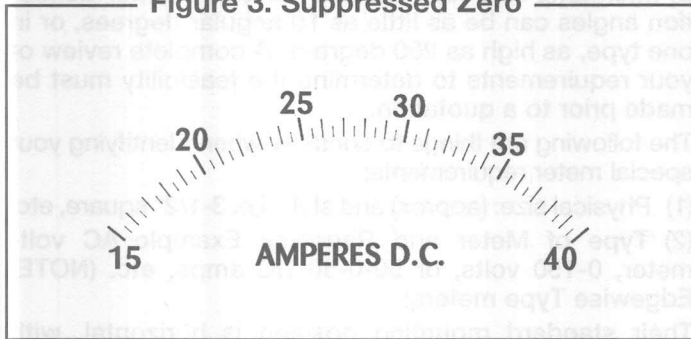
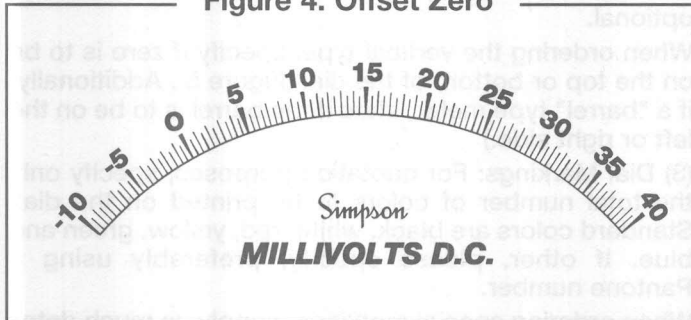


Figure 4. Offset Zero



zero and the meter does not indicate until 15 or greater is reached. The pointer continues to a maximum of 40 at full scale. This improves readability by having 30 units on a scale which would normally have 100. This feature is available on DC meters or AC rectifier type, with suppression up to 50% of full scale. AC moving iron vane type meters, 30% maximum (Figure 3).

Offset Zero

This type locates the zero at any place on the scale except scale ends or center scale. Example: -10-0-40 (Figure 3).

Zero Location For Edgewise Type Meters

See "Quotation/Ordering Information."

Internal Resistance and Sensitivity

All meters have electrical resistance. Many can be special-ordered with higher or lower values than specified in this publication.

Also DC and AC rectifier type voltmeters are available in higher sensitivities than mentioned herein.

Sensitivity relates to the maximum current required by the voltmeter to indicate full scale. It is expressed in "Ohms Per Volt." This can be critical when voltmeters are used in circuits having little total current. The most convenient way of converting ohms per volt into current is to divide the number one by the number of ohms per volt. Example: 1000 ohms per volts = $1.000 \div 1000 = .001$, or 1mA.

Temperature Compensation

Internal temperature compensation of Simpson meters meets or exceeds requirements of specification ANSI C39.1-1981, "Requirements for Electrical Analog Indicating Instruments," which specifies that accuracy shall be held at $23^{\circ}\pm 10^{\circ}\text{C}$. Meters that maintain accuracy over a broader temperature span usually can be provided.

Multi Range Meters (self-contained)

Panel space limitations, convenience and/or cost may call for a meter capable of measuring more than one

range of electrical quality. For example, a voltmeter with a double range of 0-100, 0-200 volts, or triple range of 0-100, 200 and 300 volts. The back of the meter would contain the necessary connections, one common, and one additional for each range. Thus, a dual range meter would have three connections and a triple range four. This type meter is available for voltage measurements and for many ranges of microamps and milliamps.

Controllers (Analog Type)

A few of our analog panel meters are available with control features. These meters combine standard analog display with adjustable on and off electronic switch and output relays.

The analog controller can be supplied to respond to practically any current or voltage input. The input signal is amplified in solid state circuitry and is continuously displayed on a rugged high torque pivot and jewel or taut band suspension type D'Arsonval meter.

All voltage ranges have a 20,000 ohm per volt sensitivity, and current ranges have a 50 millivolt drop.

The input signal, indicated by the meter, is constantly monitored and compared to the set point position by the electronic circuit. When the two coincide, the electronic circuit either energizes or de-energizes the self-contained output relays, depending on the direction of the input signal.

A high gain transistor switch circuit provides switching with a "dead band" no more than 0.5% of full scale. Fail safe circuitry opens the output relay in the event of a power failure.

Ballistics

Damping

Damping is the manner in which the pointer settles at its steady indication after a change in the value of the measured quantity. The two general classes of damped motion are:

- Periodic, in which the pointer oscillates about the final position before coming to rest;
- Aperiodic, in which the pointer comes to rest without overshooting the rest position.

The point of change between periodic and aperiodic damping is called "critical damping."

Critical damping is when the overshoot present does not exceed an amount equal to one half the rated accuracy of the meter. Simpson meters are periodic and in accordance with ANSI C39.1-1981.

Standard meters have a damping factor of 2.5 minimum. Higher damping factors, for less overshoot, can usually be supplied.

Response Time

Response Time is the time required after an abrupt change of the measured quantity to a new constant value, until the pointer first comes to rest in its new position.

Often, meter applications require a special damping and/or response time. Variations from standard are available on many different types and ranges of meters. This is obtained by meter design. Besides specifying the physical size of the meter, its electrical range, and desired damping and response time, furnish the approximate resistance of the external circuit in which the meter will operate.

Frequency Calibration

AC moving iron vane type voltmeters are calibrated on a 60Hz sine wave to an accuracy of 62% of full scale, and are usable from 25 to 125 Hz. On special order, the meter can be calibrated for any specific frequency desired between 125 and 800Hz. Rectifier type meters have essentially flat response from 25 through 10,000 Hz. On special order, rectifier type can be provided that has flat response to 250 kHz.

Non Standard Lead Resistance

DC Ammeters With External Shunts

DC ammeters, for use with external shunts, are calibrated for use with industry standard leads 5 feet long with resistance of .065 ohms. On special order, meters can be calibrated to any specific lead resistance.

AC Ammeters With External Transformers

AC ammeters, made for use with typical external ring/donut type transformers, are basically 0-5 AC ammeters. The transformers are designed to produce a 5 amp output for each primary range. For example, if a 300 amp range is chosen, it is shown as a 300/5 amp, indicating that 300 amps in the end user's conductor (primary) will result in a 5 amp output from the transformer (secondary). The 0-5 amp meter would have a dial reading of 0-300 amps.

Readily available instrument transformers of this type are equipped with two connecting leads 2 feet long, and the transformer is rated at approximately 2 VA. Where necessary, this VA rating generally permits use of extension leads up to 10 feet additional using 12 gauge or larger wire. At longer distances, meter accuracy may noticeably deteriorate.

When distance is a problem and it is necessary to use an external transformer, an approach permitting distances up to 500 feet is required.

If the current to be measured is 50 AC amps or less, select the appropriate range of Simpson model 186 current transformer (refer to Accessory Section). This transformer's primary is connected in series with the circuit carrying the current to be measured.

Rated output of this transformer is 10 AC volts at full rated input current. The meter required must have an electrical range of 0-10 AC volts, with a sensitivity of approximately 2000 ohms per volt (rectifier type). The dial of the meter is captioned in AC current and the scale range corresponds to the transformer's range. Connecting conductors, from the meter to the transformer, could be as small as 18 gauge.

Amperages in excess of 50 amps can easily be measured using this method. A typical ring/donut transformer, however, becomes an added component. (A) Select the appropriate primary range of donut transformer (refer to Accessory Section). (B) The 5 amp model 186 transformer (Cat. #01312) must be used. The 5 amp output leads from the donut transformer are connected to the model 186. (C) The meter and its connecting wiring are as outlined above, except its dial scale is to correspond in range to the newly added donut transformers.

Quotation/Ordering Information

Meter movements only, i.e. no case enclosure or dial, calibrated or uncalibrated, can be supplied in a variety

of microamp and low milliamp ranges. Pointer deflection angles can be as little as 10 angular degrees, or in one type, as high as 250 degrees. A complete review of your requirements to determine the feasibility must be made prior to a quotation.

The following are things to consider when identifying your special meter requirements:

- (1) Physical size: (approx) and style, i.e. 3-1/2" square, etc.
- (2) Type of Meter and Range(s): Example: AC voltmeter, 0-150 volts, or 50-0-50 DC amps, etc. (NOTE: Edgewise Type meters:

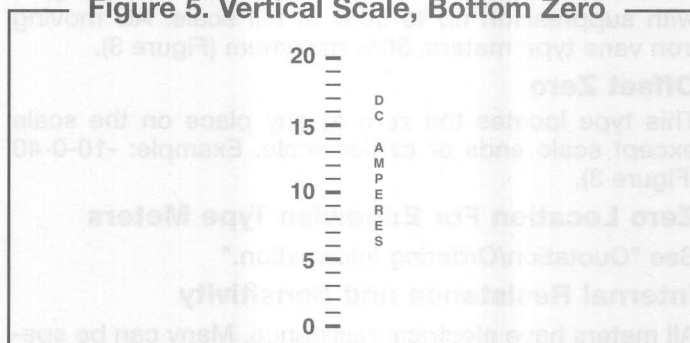
Their standard mounting position is horizontal, with zero at left. Zero right, zero center or offset zero is optional.

When ordering the vertical type, specify if zero is to be on the top or bottom of the dial (Figure 5). Additionally, if a "barrel" type meter, state if the barrel is to be on the left or right side.)

- (3) Dial Markings: For quotation purposes, specify only the total number of colors to be printed on the dial. Standard colors are black, white, red, yellow, green and blue. If other, please specify, preferably using a Pantone number.

When ordering special markings, supply as much detail as possible. Where details lack, we will apply normal good practice procedure. If a special trademark or logo is required, a good reproducible positive or film is needed.

Figure 5. Vertical Scale, Bottom Zero



Upon request, for your approval, a photostat (actual size) of the final layout can be furnished.

Changes can be made at this point, prior to etching the permanent dial printing plate.

(4) Special Features

(a) Type of Pointer: spade, knife edge or lance. Specify color. Standard is black, white or fluorescent red. If other, specify using a Pantone color number.

(b) Mirror Dial: A small mirror segment used to eliminate reading errors due to parallax. Not available on all models.

(c) Electrical: If a non-standard resistance is required, state the desired value and tolerance. If it is to be at other than room temperature, state temperature span.

(d) Ballistics (damping/response time): State requirements and furnish the approximate resistance of the circuit in which the meter will operate.

(e) Tracking/Symmetry: If other than standard, state requirement. For a detailed description, see the section on "Modification/Special Features."

(f) Accuracy: If other than standard, state requirement.

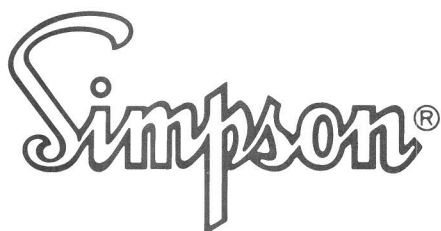


Accessories

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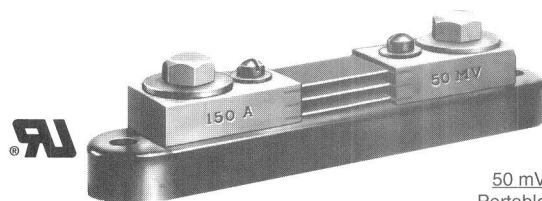
Accessories

External Portable and Switchboard Shunts

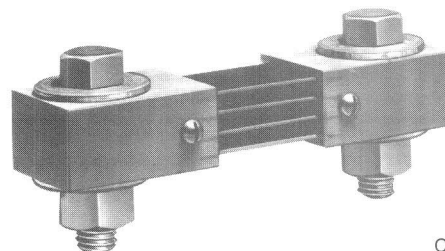
- **Portable Shunts Up to 200 Amps**
- **Switchboard Shunts Up to 500 Amps**
- **Reduces High DC Current Signal Into Either 50 or 100 Millivolt Drop**
- **Accuracy $\pm 1\%$ 5 Inch Leads (0.065 ohms) Included**
- **Shunts Can Be Certified to NIST Standards**

Simpson's Portable and Switchboard shunts enable a panel meter to indicate higher currents than can be provided with a self-contained internal shunt. A typical shunt installation in series with the load and source is shown in the application section. These shunts can be used with either digital or analog meters. Most digital DC millivolt meters that Simpson manufactures can be scaled to display the actual current. Simpson can custom design any dial for the analog meters you require. Simpson manufactures two types of external shunts: Portable and Switchboard shunts.

Portable shunts are mounted in a phenolic base. This base allows the shunt to be easily installed in many locations. Portable shunts come in a 50 millivolt



50 mV Shunts
Portable 150 amp
Catalog No. 06714



Switchboard
100 amp
Catalog No. 06500

drop and a 100 millivolt drop. The most commonly used is the 50 millivolt unit.

Switchboard shunts mount directly onto a buss bar and have a 50 millivolt drop. They have the same quality construction as a portable shunt, but without the phenolic base.

Leads for these shunts are 5 feet long and are rated at 0.065 ohms resistance. Shunts with a 100 amp rating and below can be certified to NIST standards.

1	1-1/16"	1/4"	1/4-20
1-1/2	1-1/16"	1/4"	1/4-20
2	1-1/16"	1/4"	1/4-20
3	1-1/16"	1/4"	1/4-20
5	1-1/16"	1/4"	1/4-20
7-1/2	1-1/16"	1/4"	1/4-20
10	1-1/16"	1/4"	1/4-20
15	1-1/16"	1/4"	1/4-20
20	1-1/16"	1/4"	1/4-20

25	1-1/16"	1/4"	1/4-20
30	1-1/16"	1/4"	1/4-20
50	1-5/16"	1/2"	3/8-16
60	1-5/16"	1/2"	3/8-16
75	1-5/16"	1/2"	3/8-16
80	1-5/16"	1/2"	3/8-16
100	1-5/16"	1/2"	3/8-16
150	1-5/16"	1/2"	3/8-16
200	1-5/16"	1/2"	3/8-16

Dimension Table

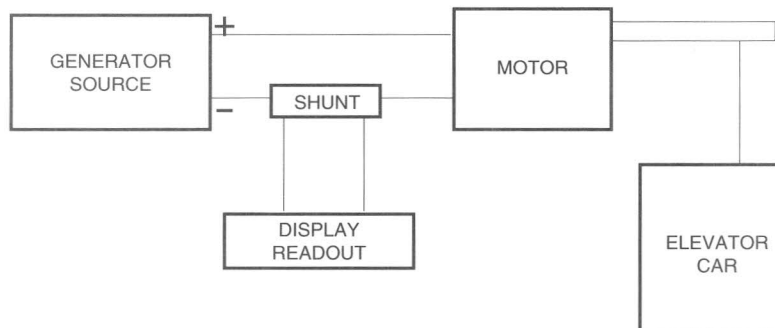
Amps	A	B	C	D	E
100	4-1/2"	1"	3-1/2"	1/2"	3/8-16x1-1/2
125	4-1/2"	1"	3-1/2"	1/2"	3/8-16x1-1/2
150	4-1/2"	1"	3-1/2"	1/2"	3/8-16x1-1/2
200	4-1/2"	1"	3-1/2"	1/2"	3/8-16x1-1/2
300	5-1/2"	1-1/2"	4"	1"	1/2-13x2
400	5-1/2"	1-1/2"	4"	1"	1/2-13x2
500	5-1/2"	1-1/2"	4"	1"	1/2-13x2

Typical Application

A motor is connected to a 220 Volt power generator, and running requirements call for 100 Amps. This motor is attached to an elevator, and the heavier the weight in the car the higher the current draw. There is a need to monitor the current draw of the motor to insure that an overweight car is not moved and the motor not damaged.

A break is made in the common line between the motor and the

power source. A shunt with a ratio of 100 DC amps/50 DC millivolts is installed in this break. An analog or digital panel meter is connected to the small screws on the shunt. The current draw will be converted to a DC millivolt signal for the meter. If the ratio of Amps to car weight is known, a digital unit can be scaled to indicate the engineering unit you desire. Custom dials are available for analog meters.



Ordering Information

Portable Shunts 50 mV

Amps	Catalog Number
1	06700
5	06703
10	06704
15	06705
25	06707
30	06708
50	06709
75	06711
100	06713
150	06714
200	06715

Portable Shunts 100 mV

Amps	Catalog Number
10	06716
100	06717

NOTE: 5' leads not included

Switchboard Shunts 50 mV

Amps	Catalog Number
100	06500
150	06503
200	06504
250	06505
300	06506
400	06507
500	06508



Accessories

MODEL TR700 & TR800

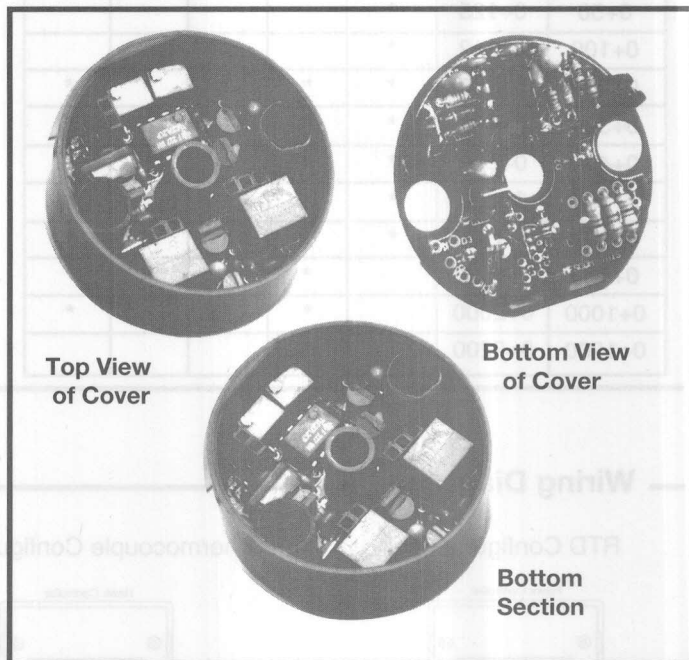
TWO-WIRE, 4-20 mA, TRANSMITTERS
(Isolated and Non-Isolated)

- **Compact Size, 1.73" (44mm) in Diameter For Quick Fit in Most Industrial Protection Heads**
- **High Precision (Accuracy = 0.1% of Span), Low Cost**
- **Enhanced RFI and EMI Protection for Better Measurement Stability**
- **Universal Input Capability Accommodating Thermocouple Types J, K, T, R, S, E, mV, and Pt-100 RTD for Complete Field Ranging**
- **Fixed-Range Units Offered in Standard or Special**

Simpson's new models TR700 and TR800 are high precision, low cost transmitters designed to control an output current (4-20 mA) in a linear relationship with a low level input signal for accurate transmission over long distances.

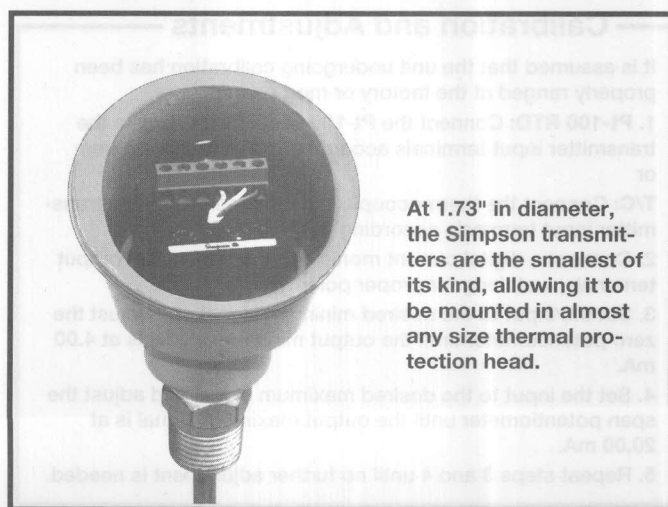
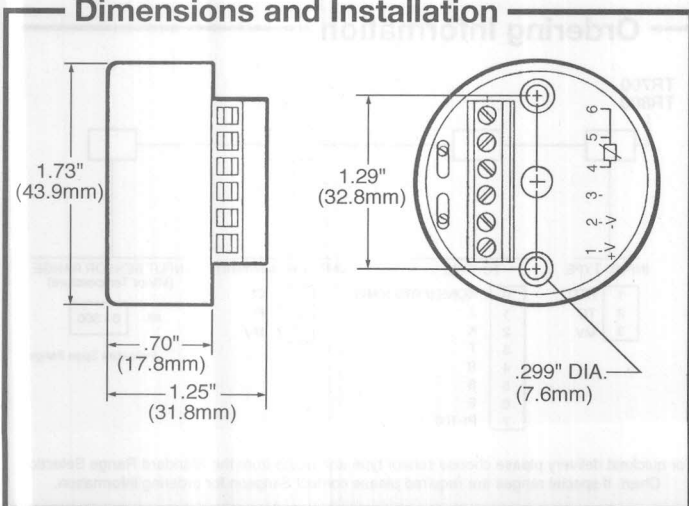
Model TR700: The Simpson TR700 provides isolated, 2-wire, 4-20 mA amplification of low level process signals, including J, K, T, R, S, E, mV, and Pt-100 RTD. Each transmitter offers 2 or 3-wire compensation and linearization for Pt-100 and ice point reference compensation for thermocouples. The TR700 provides 500 VDC input/output isolation preventing ground loops and operational errors. This assures a stable 4-20 mA output signal transmitted directly from the measuring source.

Model TR800: The TR800 is the non-isolated version of the TR700. The TR800 provides two-wire, 4-20mA amplification of low level process signals, including J, K, T, R, S, E, mV, and Pt-100 inputs. Pt-100 units (models TR700 & TR800) are linearized and thermocouple units are voltage linear.



On both models TR700 and TR800, range is determined by a set of internally mounted resistors. No soldering of resistors is required which allows for easy configuring of unit in the field. To assist in field ranging and calibration of your transmitter, Simpson offers the optional transmitter calibration kit which includes calibration procedure information and a diskette for use with an IBM compatible PC. (Catalog #21254). While the TR700 & TR800 are easy to configure, many users prefer the factory to configure. Fixed range units are offered in standard or special ranges; customized for your individual application.

Dimensions and Installation



At 1.73" in diameter, the Simpson transmitters are the smallest of its kind, allowing it to be mounted in almost any size thermal protection head.

Specifications

PERFORMANCE

Accuracy: $\pm 0.1\%$ of span

Adjustability: $\pm 25\%$ for both zero and span

Burnout Detection: Upscale-standard

Standard Range Selection Chart - Sensor Type

$^{\circ}\text{C}$	$^{\circ}\text{F}$	RTD	K	J	T	E
-50+50	-50+125	*				
0+50	0+125	*				
0+100	0+212	*				
0+200	0+300	*	*	*	*	*
0+300	0+400	*	*	*	*	*
0+400	0+500	*	*	*	*	*
0+500	0+750	*	*	*	*	*
0+600	0+1000	*	*	*		*
0+800	0+1500		*	*		*
0+1000	0+2000		*	*		*
0+1200	0+2200		*			

INPUT

RTD: Pt-100, 2 or 3 wire

TC: all known types

Linearity: [TR700] Better than $\pm 0.1\%$ of span (for both RTD & TC/mV)

[TR800] Better than $\pm 0.03\%$ of span (for TC/mV), $\pm 0.05\%$ of span (for RTD)

Stability (For Both Zero & Span): Pt-100 (100 $^{\circ}\text{C}$ span): [TR700] 0.02% of span/ $^{\circ}\text{C}$, [TR800] 0.03% of span/ $^{\circ}\text{C}$, TC/mV (25 mV input): [TR700] 0.02% of span/ $^{\circ}\text{C}$, [TR800] 0.04% of span/ $^{\circ}\text{C}$

T/C Cold Junction Compensation: $< 0.05^{\circ}\text{C}/^{\circ}\text{C}$ of ambient temperature

INPUT SPAN

RTD: 20 $^{\circ}\text{C}$ (36 $^{\circ}\text{F}$) min, 500 $^{\circ}\text{C}$ (900 $^{\circ}\text{F}$) max

TC: [TR700] 5 mV min span, [TR800] 10 mV min span

OUTPUT

Range: 4-20 mA DC

Limit: 2.5 to 28 mA

Maximum Load: $R_{\text{max}} = (V_{\text{supply}} - 10V) \div 20 \text{ mA}$

ENVIRONMENTAL

Ambient Temperature: -20 + 70 $^{\circ}\text{C}$ (-4 + 160 $^{\circ}\text{F}$)

Humidity: 0-95% RH, non-condensing

Isolation: 500 VDC or peak AC (for TR700 only)

ELECTRICAL

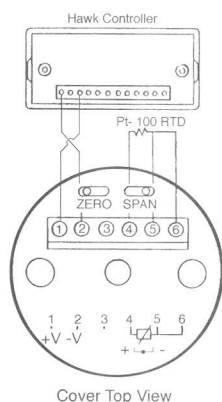
Supply Voltage: [TR700] 10-40 VDC polarity protected

[TR800] 8-38 VDC polarity protected

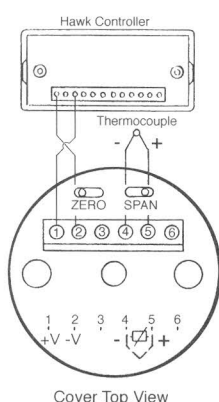
RFI and EMI immunity from 20MHz to 500MHz

Wiring Diagrams

RTD Configuration



Thermocouple Configuration



Both the model TR700 and TR800 should be configured in the same manner.

1. Connect the positive supply lead to terminal one.
2. Connect the negative supply lead to terminal two.
3. For Pt-100 RTD Inputs, connect the Pt-100 leads to input terminals 4, 5, and 6 according to the RTD wiring diagram.
4. For thermocouple inputs, connect the thermocouple leads to input terminals 4 and 5 according to the thermocouple wiring diagram.

Calibration and Adjustments

It is assumed that the unit undergoing calibration has been properly ranged at the factory or mod center.

1. **Pt-100 RTD:** Connect the Pt-100 sensor simulator to the transmitter input terminals according to the wiring diagram or

T/C: Connect the thermocouple sensor simulator to the transmitter input terminals according to the wiring diagram.

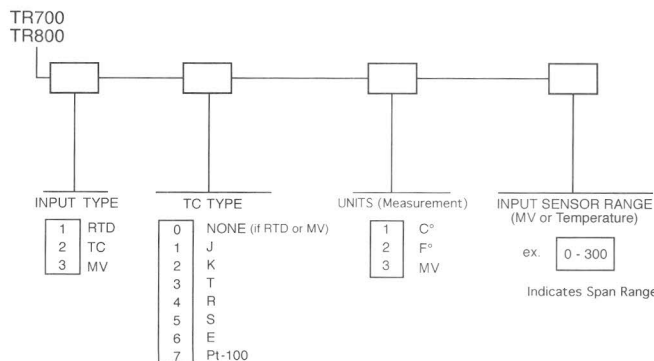
2. Connect a digital current monitor to the transmitter output terminals, watching for proper polarity.

3. Set the input to the desired minimum signal and adjust the zero potentiometer until the output minimum signal is at 4.00 mA.

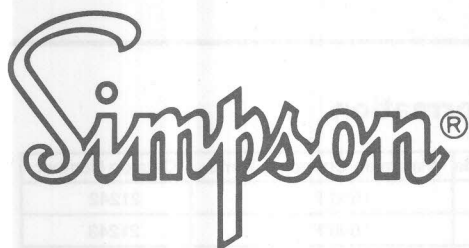
4. Set the input to the desired maximum signal and adjust the span potentiometer until the output maximum signal is at 20.00 mA.

5. Repeat steps 3 and 4 until no further adjustment is needed.

Ordering Information



For quickest delivery please choose sensor type and range from the Standard Range Selection Chart. If special ranges are required please contact Simpson for ordering information.



Accessories

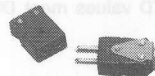
Thermocouples/RTD

- **Quick Disconnect Thermocouple Assemblies**
316 SS-Ungrounded Junction
- **Rugged Metal Transition Thermocouple/RTD Assemblies with Teflon Coated Lead Wire**
- **Flexibility of XACTPAK® Material**
- **Thermocouple Insulated Softwire**
Standard and Custom Cut Lengths
- **ANSI Color Coded Thermocouple Connectors with Exclusive Channel Design**
- **Compression Fittings-Adjustable and Non-Adjustable Types**

Simpson has expanded its line of temperature accessories by adding soft-wire thermocouples, mineral-insulated (MI) temperature assemblies, connectors and compression fittings. Soft wire thermocouples are available in five insulation types and varying gauge sizes to satisfy a wide range of temperature requirements. Simpson's quick-disconnect thermocouple assemblies feature ANSI color coded plug and jack connectors for easy connection, saving you time. Metal transition thermocouple/RTD assemblies allow extra protection against frequent bending and twisting. Each MI probe is manufactured with XACTPAK®. Unlike other MI thermocouples, the flexibility of the XACTPAK® material allows you to bend the thermo-



Metal Transition



Quick Disconnect



Insulated Soft Wire

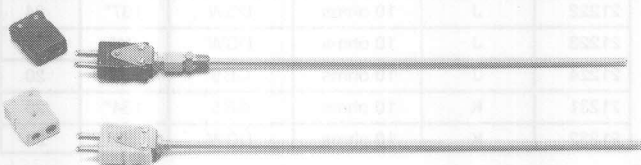
Type	Temperature/Range	Tolerances†
J	32 to 1382°F 0 to 750°C	±2.2°C or ±0.75%
K	32 to 2282°F 0 to 1250°C	±2.2°C or ±0.75%
T	32 to 662°F 0 to 350°C	±1.0°C or ±0.75%
E	32 to 1652°F 0 to 900°C	±1.7°C or ±0.5%
KX*	32 to 392°F 0 to 200°C	±2.2°C or ±0.75%

* Extension Wire-Type K Calibration

† For Fahrenheit, multiply tolerance in °C by 1.8.

couple without risk of cracking. Lightweight, rugged, and accurate, Simpson's standard connectors isolate all wire for clean, strong signals. In addition, adjustable and non-adjustable compression fittings are offered to set immersion length in the field. All thermocouples meet Standard Tolerances per ANSI MC96.1-1982. For thermoelectric voltage information please refer to the following pages.

Quick Disconnect Assemblies



Quick disconnect thermocouple assemblies are fast-responding, durable, and capable of handling higher temperatures than uninsulated types. The compacted XACTPAK® MI insulation further enhances the sensor's ability to "read" temperature by transferring heat quickly to the measuring junction while it protects the thermocouple from moisture and thermal shock. The 12 inch, 3/16 in diameter thermocouple probe has an ungrounded junction and is made of 316 stainless steel.

Specifications

316 Stainless Steel

Best corrosion resistance of the austenitic stainless steel grades. Good corrosion resistance in H2S. Subject to damaging carbide precipitation in 900°-1600°F (482°-871°C) range.

Ungrounded Junction

This type of thermocouple junction is fully insulated from the welded sheath end. The ungrounded junction is excellent for applications where stray EMFs would affect the reading and for frequent or rapid temperature cycling. Response time is 2.5 seconds.

Forming

The XACTPAK® sheath can be formed around a mandrel twice the sheath diameter without damage.

Ordering Information

Type	ANSI Color Code	Maximum Operating Temperature	Catalog Number
J	Black	1500°F	21238
K	Yellow	1600°F	21239
T	Blue	662°F	21240
E	Purple	1600°F	21241

Note: All selections include standard plug and jack connectors.

Accessories

Compression Fittings

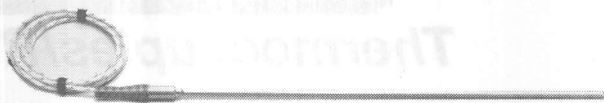
These fittings can be applied at any point along the sheath. They are used to mount a thermocouple assembly at a given depth, or to mount a thermocouple head on an assembly. The two types available are: non-adjustable and adjustable.

Single Threaded		Sheath O.D. Inches	Bore ±0.001 Inches	Male NPT Inches	Hex Across Flats Inches
Catalog #	Length				
21237 21253	1-1/4"	3/16	0.194	1/8	1/2

Plugs and Jacks

Type	Ansi Color Code	Plug Cat #	Jack Cat #	Description
J	Black	21245	21249	Standard 7/16
K	Yellow	21246	21250	inch pin spacing
T	Blue	21247	21251	Ambient temp
E	Purple	21248	21252	rating 400°F(205°C)

Metal Transition Assemblies



Metal transition thermocouple/RTD assemblies are offered in J, K, and Platinum 100 RTD calibrations. They provide maximum temperature measurements of 1650°F (900°C), for excellent corrosion resistance. The probe includes 48 inches of FEP Teflon® coated thermocouple wire and stripped leads. The coiled spring strain relief protects the wire against sharp bends in the transition area. All insulation resistance for RTD values meet DIN 0.00385 standard tolerance class B.

Specifications

316 Stainless Steel

Best corrosion resistance of the austenitic stainless steel grades. Good corrosion resistance in H₂S. Widely used in the food and chemical industry. Subject to damaging carbide precipitation in 900°-1600°F (482°-871°C) range.

Ungrounded Junction

This thermocouple junction is fully insulated from the welded sheath end. The ungrounded junction is excellent for applications where stray EMFs would affect the reading and for frequent or rapid temperature cycling. Response time is 2.5 seconds.

Maximum Continuous Operating Temperature

Epoxy rated at 300°F (150°C) for the transition.

Ordering Information

Type	ANSI Color Code	Maximum Operating Temp	Catalog Number
J	Black	1500°F	21242
K	Yellow	1600°F	21243
RTD	White	1200°F	21244

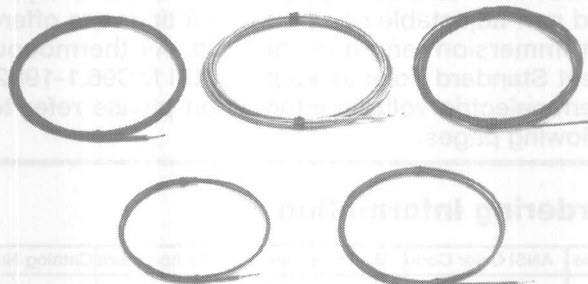
Accessories

Compression Fittings

Mounting fittings can be applied at any point along the sheath. They are used to mount a thermocouple assembly at a given depth, or to mount a thermocouple head on an assembly. The two types of compression fittings available are non-adjustable and adjustable compression types.

Single Threaded		Sheath O.D.	Bore ±0.001	Male NPT	Hex Across Flats
Catalog #	Length	Inches	Inches	Inches	Inches
21237	1-1/4	Non-Adjustable		1/8	1/2
		3/16"	0.194		
21253	1-1/4	Adjustable		1/8	1/2
		3/16"	0.193		

Insulated Soft Wire - Standard and Custom



Soft-wire thermocouples are available in five insulation types, in custom lengths for special applications, and in varying gauge sizes. All soft wire selections have beaded butt welded measurement junctions. For cold junction terminations, standard thermocouple selections have eye terminal (1/4" screw size) for use with analog meters. Custom thermocouples have solid bare wire.

Specifications

Type	Temperature Rating		Physical Properties		
	Continuous	Single Reading	Abrasion Resistance	Moisture Resistance	Chemical Resistance
Glass Braid	900°F (482°C)	1000°F (538°C)	Fair	Good	Good
Glass Braid (SS)	900°F (482°C)	1000°F (538°C)	Fair	Good	Good
Double Glass Wrap	900°F (482°C)	1000°F (538°C)	Fair	Good	Good
Teflon®	400°F (204°C)	500°F (260°C)	Excellent	Excellent	Excellent
High Temp Braid	1300°F (704°C)	1600°F (871°C)	Good	Good	Good

Ordering Information

Standard

Cat. No.	T/C Type	Resistance	Overbraid	Length	Gauge
21221	J	5 ohms	GBS	162"	20
21222	J	10 ohms	DGW	137"	24
21223	J	10 ohms	DGW	34"	30
21224	J	10 ohms	GBS	325"	20
21231	K	10 ohms	GBS	154"	20
21232	K	10 ohms	DGW	90"	24

Custom

Thermocouple Type	Wire Gauge Size	Insulation Type (see table)	Thermocouple Length in (feet)
J K T E	J K T E	0 1 2 3 4	GB GBS DGW FEP HTB

Thermocouple Insulation Types Available

Type	T/C Type	Gauge Size
GB	J, K, T	20, 24
GBS	J, K	20
DGW	J, K	24
FEP	J, K	20
HT8	E	20

GB = Glass Braid
GBS = Glass Braid w/Stainless Steel Wrap
DGW = Double Glass Wrap
FEP = HighTemp. Plastic Equal to Teflon®
HTB = High Temp. Glass Braid

Accessories

Extension Wire

This economical grade of wire is constructed with extruded PVC for both single and duplex conductor insulation. This insulation provides excellent moisture resistance, good abrasion and chemical resistance, while performing continuously at temperatures to 220°F (104.4°C).

Catalog Number	Description
21234	10 ohm extension grade, K type, solid wire, 43 feet
21235	10 ohm extension grade, K type, solid wire, 17 feet



Type E Thermocouples

Thermoelectric Voltage in Millivolts

Fahrenheit

Incremental degrees in Fahrenheit																							
°F	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
												0	-1.026	-0.994	-0.963	-0.931	-0.900	-0.868	-0.836	-0.805	-0.773	-0.741	-0.709
												10	-0.709	-0.677	-0.645	-0.614	-0.582	-0.550	-0.517	-0.485	-0.453	-0.421	-0.389
												20	-0.389	-0.357	-0.324	-0.292	-0.260	-0.227	-0.195	-0.163	-0.130	-0.098	-0.065
												30	-0.065	-0.033	0.000	0.033	0.065	0.098	0.131	0.163	0.196	0.229	0.262
-450	-9.830	-9.832	-9.833	-9.834	-9.835							40	-0.262	-0.294	0.327	0.360	0.393	0.426	0.459	0.492	0.525	0.558	0.591
-440	-9.809	-9.812	-9.814	-9.817	-9.819	-9.821	-9.823	-9.825	-9.827	-9.829	-9.830	50	0.591	0.624	0.657	0.691	0.724	0.757	0.790	0.824	0.857	0.890	0.924
-430	-9.775	-9.779	-9.782	-9.786	-9.790	-9.793	-9.797	-9.800	-9.803	-9.806	-9.809	60	0.924	0.957	0.990	1.024	1.057	1.091	1.124	1.158	1.192	1.225	1.259
-420	-9.729	-9.734	-9.739	-9.744	-9.749	-9.753	-9.758	-9.762	-9.766	-9.771	-9.775	70	1.259	1.292	1.326	1.360	1.394	1.427	1.461	1.495	1.529	1.563	1.597
-410	-9.672	-9.678	-9.684	-9.690	-9.696	-9.702	-9.707	-9.713	-9.718	-9.724	-9.729	80	1.597	1.631	1.665	1.699	1.733	1.767	1.801	1.835	1.869	1.904	1.938
-400	-9.604	-9.611	-9.618	-9.625	-9.632	-9.639	-9.646	-9.653	-9.659	-9.666	-9.672	90	1.938	1.972	2.006	2.041	2.075	2.109	2.144	2.178	2.212	2.247	2.281
-390	-9.525	-9.534	-9.542	-9.550	-9.558	-9.566	-9.574	-9.581	-9.589	-9.597	-9.604	100	2.281	2.316	2.351	2.385	2.420	2.454	2.489	2.524	2.558	2.593	2.628
-380	-9.436	-9.446	-9.455	-9.464	-9.473	-9.482	-9.491	-9.500	-9.508	-9.517	-9.525	110	2.628	2.663	2.698	2.733	2.767	2.802	2.837	2.872	2.907	2.942	2.977
-370	-9.338	-9.348	-9.358	-9.368	-9.378	-9.388	-9.398	-9.408	-9.417	-9.427	-9.436	120	2.977	3.012	3.048	3.083	3.118	3.153	3.188	3.224	3.259	3.294	3.330
-360	-9.229	-9.241	-9.252	-9.263	-9.274	-9.285	-9.295	-9.306	-9.317	-9.327	-9.338	130	3.330	3.365	3.400	3.436	3.471	3.507	3.542	3.578	3.613	3.649	3.685
-350	-9.112	-9.124	-9.136	-9.148	-9.160	-9.172	-9.184	-9.195	-9.207	-9.218	-9.229	140	3.685	3.720	3.756	3.792	3.827	3.863	3.899	3.935	3.970	4.006	4.042
-340	-8.986	-8.999	-9.012	-9.025	-9.038	-9.050	-9.063	-9.075	-9.088	-9.100	-9.112	150	4.042	4.078	4.114	4.150	4.186	4.222	4.258	4.294	4.330	4.366	4.403
-330	-8.852	-8.866	-8.880	-8.893	-8.907	-8.920	-8.934	-8.947	-8.960	-8.973	-8.986	160	4.403	4.439	4.475	4.511	4.547	4.584	4.620	4.656	4.693	4.729	4.766
-320	-8.710	-8.725	-8.739	-8.754	-8.768	-8.782	-8.797	-8.811	-8.825	-8.839	-8.852	170	4.766	4.802	4.839	4.875	4.912	4.948	4.985	5.021	5.058	5.095	5.131
-310	-8.561	-8.576	-8.591	-8.607	-8.622	-8.637	-8.652	-8.666	-8.681	-8.696	-8.710	180	5.131	5.168	5.205	5.242	5.278	5.315	5.352	5.389	5.426	5.463	5.500
-300	-8.404	-8.420	-8.436	-8.452	-8.468	-8.483	-8.499	-8.515	-8.530	-8.546	-8.561	190	5.500	5.537	5.574	5.611	5.648	5.685	5.722	5.759	5.796	5.833	5.871
-290	-8.240	-8.257	-8.273	-8.290	-8.307	-8.323	-8.339	-8.356	-8.372	-8.388	-8.404	200	5.871	5.908	5.945	5.982	6.020	6.057	6.094	6.132	6.169	6.207	6.244
-280	-8.069	-8.087	-8.104	-8.121	-8.138	-8.155	-8.173	-8.189	-8.206	-8.223	-8.240	210	6.244	6.281	6.319	6.356	6.394	6.432	6.469	6.507	6.544	6.582	6.620
-270	-7.891	-7.910	-7.928	-7.945	-7.963	-7.981	-7.999	-8.017	-8.034	-8.052	-8.069	220	6.620	6.658	6.695	6.733	6.771	6.809	6.847	6.884	6.922	6.960	6.998
-260	-7.707	-7.726	-7.745	-7.763	-7.782	-7.800	-7.819	-7.837	-7.855	-7.873	-7.891	230	6.998	7.036	7.074	7.112	7.150	7.188	7.226	7.264	7.302	7.341	7.379
-250	-7.516	-7.536	-7.555	-7.574	-7.593	-7.613	-7.632	-7.651	-7.670	-7.688	-7.707	240	7.379	7.417	7.455	7.493	7.532	7.570	7.608	7.647	7.685	7.723	7.762
-240	-7.319	-7.339	-7.359	-7.379	-7.399	-7.419	-7.438	-7.458	-7.478	-7.497	-7.516	250	7.762	7.800	7.839	7.877	7.916	7.954	7.993	8.031	8.070	8.108	8.147
-230	-7.116	-7.137	-7.157	-7.178	-7.198	-7.219	-7.239	-7.259	-7.279	-7.299	-7.319	260	8.147	8.186	8.224	8.263	8.302	8.340	8.379	8.418	8.457	8.496	8.535
-220	-6.907	-6.928	-6.950	-6.971	-6.992	-7.013	-7.033	-7.054	-7.075	-7.096	-7.116	270	8.535	8.573	8.612	8.651	8.690	8.729	8.768	8.807	8.846	8.885	8.924
-210	-6.692	-6.714	-6.736	-6.757	-6.779	-6.801	-6.822	-6.843	-6.865	-6.886	-6.907	280	8.924	8.963	9.002	9.041	9.081	9.120	9.159	9.198	9.237	9.277	9.316
-200	-6.472	-6.494	-6.516	-6.539	-6.561	-6.583	-6.605	-6.627	-6.649	-6.671	-6.692	290	9.316	9.355	9.395	9.434	9.473	9.513	9.552	9.591	9.631	9.670	9.710
-190	-6.246	-6.269	-6.291	-6.314	-6.337	-6.359	-6.382	-6.405	-6.427	-6.449	-6.472	300	9.710	9.749	9.789	9.828	9.868	9.907	9.947	9.987	10.026	10.066	10.106
-180	-6.014	-6.037	-6.061	-6.084	-6.107	-6.130	-6.154	-6.177	-6.200	-6.223	-6.246	310	10.106	10.145	10.185	10.225	10.265	10.304	10.344	10.384	10.424	10.464	10.503
-170	-5.777	-5.801	-5.825	-5.849	-5.872	-5.896	-5.920	-5.943	-5.967	-5.991	-6.014	320	10.503	10.543	10.583	10.623	10.663	10.703	10.743	10.783	10.823	10.863	10.903
-160	-5.535	-5.559	-5.584	-5.608	-5.632	-5.656	-5.681	-5.705	-5.729	-5.753	-5.777	330	10.903	10.943	10.983	11.024	11.064	11.104	11.144	11.184	11.224	11.265	11.305
-150	-5.287	-5.312	-5.337	-5.362	-5.387	-5.412	-5.436	-5.461	-5.486	-5.510	-5.535	340	11.305	11.345	11.385	11.426	11.466	11.506	11.547	11.587	11.627	11.668	11.708
-140	-5.035	-5.060	-5.086	-5.111	-5.136	-5.162	-5.187	-5.212	-5.237	-5.262	-5.287	350	11.708	11.749	11.789	11.830	11.870	11.911	11.951	11.992	12.032	12.073	12.113
-130	-4.777	-4.803	-4.829	-4.855	-4.881	-4.907	-4.932	-4.958	-4.984	-5.009	-5.035	360	12.113	12.154	12.195	12.235	12.276	12.317	12.357	12.398	12.439	12.480	12.520
-120	-4.515	-4.542	-4.568	-4.594	-4.621	-4.647	-4.673	-4.699	-4.725	-4.751	-4.777	370	12.520	12.561	12.602	12.643	12.684	12.724	12.765	12.806	12.847	12.888	12.929
-110	-4.248	-4.275	-4.302	-4.329	-4.355	-4.382	-4.409	-4.436	-4.462	-4.489	-4.515	380	12.929	12.970	13.011	13.052	13.093	13.134	13.175	13.216	13.257	13.298	13.339
-100	-3.976	-4.004	-4.031	-4.058	-4.086	-4.113	-4.140	-4.167	-4.194	-4.221	-4.248	390	13.339	13.380	13.421	13.462	13.504	13.545	13.586	13.627	13.668	13.710	13.751
-90	-3.700	-3.728	-3.756	-3.784	-3.811	-3.839	-3.867	-3.894	-3.922	-3.949	-3.976	400	13.751	13.792	13.833	13.875	13.916	13.957	13.999	14.040	14.081	14.123	14.164
-80	-3.420	-3.448	-3.476	-3.504	-3.532	-3.561	-3.589	-3.617	-3.645	-3.672	-3.700	410	14.164	14.205	14.247	14.288	14.330	14.371	14.413	14.454	14.496	14.537	14.579
-70	-3.135	-3.163	-3.192	-3.221	-3.249	-3.278	-3.306	-3.335	-3.363	-3.391	-3.420	420	14.579	14.620	14.662	14.704	14.745	14.787	14.828	14.870	14.912	14.953	14.995
-60	-2.846	-2.875	-2.904	-2.933	-2.962	-2.991	-3.020	-3.048	-3.077	-3.106	-3.135	430	14.995	15.037	15.078	15.120	15.162	15.204	15.245	15.287	15.329	15.371	15.413
-50	-2.552	-2.582	-2.611	-2.641	-2.670	-2.699	-2.729	-2.758	-2.787	-2.816	-2.846	440	15.413	15.454	15.496	15.538	15.580	15.622	15.664	15.706	15.748	15.790	15.831
-40	-2.255	-2.285	-2.315	-2.344	-2.374	-2.404	-2.434	-2.463	-2.493	-2.523	-2.552	450	15.										

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F

550	20.086	20.129	20.172	20.216	20.259	20.302	20.345	20.388	20.431	20.474	20.517	1050	42.311	42.356	42.401	42.446	42.491	42.536	42.581	42.626	42.671	42.715	42.760
560	20.517	20.561	20.604	20.647	20.690	20.733	20.777	20.820	20.863	20.906	20.950	1060	42.760	42.805	42.850	42.895	42.940	42.985	43.030	43.075	43.120	43.165	43.209
570	20.950	20.993	21.036	21.080	21.123	21.166	21.209	21.253	21.296	21.339	21.383	1070	43.209	43.254	43.299	43.344	43.389	43.434	43.479	43.524	43.569	43.613	43.658
580	21.383	21.426	21.470	21.513	21.556	21.600	21.643	21.686	21.730	21.773	21.817	1080	43.658	43.703	43.748	43.793	43.838	43.883	43.928	43.972	44.017	44.062	44.107
590	21.817	21.860	21.904	21.947	21.991	22.034	22.078	22.121	22.165	22.208	22.252	1090	44.107	44.152	44.197	44.242	44.286	44.331	44.376	44.421	44.466	44.511	44.555
600	22.252	22.295	22.339	22.382	22.426	22.469	22.513	22.556	22.600	22.644	22.687	1100	44.555	44.600	44.645	44.690	44.735	44.780	44.824	44.869	44.914	44.959	45.004
610	22.687	22.731	22.774	22.818	22.862	22.905	22.949	22.993	23.036	23.080	23.124	1110	45.004	45.049	45.093	45.138	45.183	45.228	45.273	45.317	45.362	45.407	45.452
620	23.124	23.167	23.211	23.255	23.298	23.342	23.386	23.429	23.473	23.517	23.561	1120	45.452	45.497	45.541	45.586	45.631	45.676	45.720	45.765	45.810	45.855	45.900
630	23.561	23.604	23.648	23.692	23.736	23.780	23.823	23.867	23.911	23.955	23.999	1130	45.900	45.944	45.989	46.034	46.079	46.123	46.168	46.213	46.258	46.302	46.347
640	23.999	24.042	24.086	24.130	24.174	24.218	24.262	24.305	24.349	24.393	24.437	1140	46.347	46.392	46.437	46.481	46.526	46.571	46.616	46.660	46.705	46.750	46.794
650	24.437	24.481	24.525	24.569	24.613	24.657	24.701	24.745	24.789	24.832	24.876	1150	46.794	46.839	46.884	46.929	46.973	47.018	47.063	47.107	47.152	47.197	47.241
660	24.876	24.920	24.964	25.008	25.052	25.096	25.140	25.184	25.228	25.272	25.316	1160	47.241	47.286	47.331	47.375	47.420	47.465	47.509	47.554	47.599	47.643	47.688
670	25.316	25.360	25.404	25.448	25.493	25.537	25.581	25.625	25.669	25.713	25.757	1170	47.688	47.733	47.777	47.822	47.867	47.911	47.956	48.001	48.045	48.090	48.135
680	25.757	25.801	25.845	25.889	25.933	25.977	26.022	26.066	26.110	26.154	26.198	1180	48.135	48.179	48.224	48.268	48.313	48.358	48.402	48.447	48.492	48.536	48.581
690	26.198	26.242	26.286	26.331	26.375	26.419	26.463	26.507	26.552	26.596	26.640	1190	48.581	48.625	48.670	48.715	48.759	48.804	48.848	48.893	48.937	48.982	49.027
700	26.640	26.684	26.728	26.773	26.817	26.861	26.905	26.950	26.994	27.038	27.082	1200	49.027	49.071	49.116	49.160	49.205	49.249	49.294	49.338	49.383	49.428	49.472
710	27.082	27.127	27.171	27.215	27.259	27.304	27.348	27.392	27.437	27.481	27.525	1210	49.472	49.517	49.561	49.606	49.650	49.695	49.739	49.784	49.828	49.873	49.917
720	27.525	27.570	27.614	27.658	27.703	27.747	27.791	27.836	27.880	27.924	27.969	1220	49.917	49.962	50.006	50.051	50.095	50.140	50.184	50.229	50.273	50.318	50.362
730	27.969	28.013	28.057	28.102	28.146	28.191	28.235	28.279	28.324	28.368	28.413	1230	50.362	50.407	50.451	50.495	50.540	50.584	50.629	50.673	50.718	50.762	50.807
740	28.413	28.457	28.501	28.546	28.590	28.635	28.679	28.724	28.768	28.813	28.857	1240	50.807	50.851	50.895	50.940	50.984	51.029	51.073	51.118	51.162	51.206	51.251
750	28.857	28.901	28.946	28.990	29.035	29.079	29.124	29.168	29.213	29.257	29.302	1250	51.251	51.295	51.340	51.384	51.428	51.473	51.517	51.561	51.606	51.650	51.695
760	29.302	29.346	29.391	29.435	29.480	29.525	29.569	29.614	29.658	29.703	29.747	1260	51.695	51.739	51.783	51.828	51.872	51.916	51.961	52.005	52.049	52.094	52.138
770	29.747	29.792	29.836	29.881	29.925	29.970	30.015	30.059	30.104	30.148	30.193	1270	52.138	52.182	52.227	52.271	52.315	52.360	52.404	52.448	52.493	52.537	52.581
780	30.193	30.238	30.282	30.327	30.371	30.416	30.461	30.505	30.550	30.595	30.639	1280	52.581	52.625	52.670	52.714	52.758	52.803	52.847	52.891	52.935	52.980	53.024
790	30.639	30.684	30.728	30.773	30.818	30.862	30.907	30.952	3.0996	31.041	31.086	1290	53.024	53.068	53.112	53.157	53.201	53.245	53.289	53.334	53.378	53.422	53.466
800	31.086	31.130	31.175	31.220	31.264	31.309	31.354	31.398	31.443	31.488	31.533	1300	53.466	53.510	53.555	53.599	53.643	53.687	53.732	53.776	53.820	53.864	53.908
810	31.533	31.577	31.622	31.667	31.711	31.756	31.801	31.846	31.890	31.935	31.980	1310	53.908	53.952	53.997	54.041	54.085	54.129	54.173	54.218	54.262	54.306	54.350
820	31.980	32.025	32.069	32.114	32.159	32.204	32.248	32.293	32.338	32.383	32.427	1320	54.350	54.394	54.438	54.482	54.527	54.571	54.615	54.659	54.703	54.747	54.791
830	32.427	32.472	32.517	32.562	32.606	32.651	32.696	32.741	32.786	32.830	32.875	1330	54.791	54.835	54.879	54.924	54.968	55.012	55.056	55.100	55.144	55.188	55.232
840	32.875	32.920	32.965	33.010	33.054	33.099	33.144	33.189	33.234	33.278	33.323	1340	55.232	55.276	55.320	55.364	55.408	55.453	55.497	55.541	55.585	55.629	55.673
850	33.323	33.368	33.413	33.458	33.503	33.547	33.592	33.637	33.682	33.727	33.772	1350	55.673	55.717	55.761	55.805	55.849	55.893	55.937	55.981	56.025	56.069	56.113
860	33.772	33.816	33.861	33.906	33.951	33.996	34.041	34.086	34.130	34.175	34.220	1360	56.113	56.157	56.201	56.245	56.289	56.333	56.377	56.421	56.465	56.509	56.553
870	34.220	34.265	34.310	34.355	34.400	34.445	34.489	34.534	34.579	34.624	34.669	1370	56.553	56.597	56.641	56.685	56.729	56.773	56.816	56.860	56.904	56.948	56.992
880	34.669	34.714	34.759	34.804	34.849	34.893	34.938	34.983	35.028	35.073	35.118	1380	56.992	57.036	57.080	57.124	57.168	57.212	57.256	57.300	57.344	57.387	57.431
890	35.118	35.163	35.208	35.253	35.298	35.343	35.387	35.432	35.477	35.522	35.567	1390	57.431	57.475	57.519	57.563	57.607	57.651	57.695	57.738	57.782	57.826	57.870
900	35.567	35.612	35.657	35.702	35.747	35.792	35.837	35.882	35.927	35.972	36.016	1400	57.870	57.914	57.958	58.002	58.045	58.089	58.133	58.177	58.221	58.265	58.308
910	36.016	36.061	36.106	36.151	36.196	36.241	36.286	36.331	36.376	36.421	36.466	1410	58.308	58.352	58.396	58.440	58.484	58.527	58.571	58.615	58.659	58.702	58.746
920	36.466	36.511	36.556	36.601	36.646	36.691	36.736	36.781	36.826	36.870	36.915	1420	58.746	58.790	58.834	58.878	58.921	58.965	59.009	59.053	59.096	59.140	59.184
930	36.915	36.960	37.005	37.050	37.095	37.140	37.185	37.230	37.275	37.320	37.365	1430	59.184	59.228	59.271	59.315	59.359	59.402	59.446	59.490	59.534	59.577	59.621
940	37.365	37.410	37.455	37.500	37.545	37.590	37.635	37.680	37.725	37.770	37.815	1440	59.621	59.665	59.708	59.752	59.796	59.839	59.883	59.927	59.970	60.014	60.058
950	37.815	37.860	37.905	37.950	37.995	38.040	38.085	38.130	38.175	38.220	38.265	1450	60.058	60.101	60.145	60.189	60.232	60.276	60.320	60.363	60.407	60.451	60.494
960	38.265	38.309	38.354	38.399	38.444	38.489	38.534	38.579	38.624	38.669	38.714	1460	60.494	60.538	60.581	60.625	60.669	60.712	60.756	60.799	60.843	60.887	60.930
970	38.714	38.759	38.804	38.849	38.894	38.939	38.984	39.029	39.074	39.119	39.164	1470	60.930	60.974	61.017	61.061	61.105	61.148	61.192	61.235	61.279	61.322	61.366
980	39.164	39.209	39.254	39.299	39.344	39.389	39.434	39.479	39.524	39.569	39.614	1480	61.366	61.409	61.453	61.496	61.540	61.583	61.627	61.671	61.714	61.758	61.801
990	39.614	39.659	39.704	39.749	39.794	39.839	39.884	39.929	39.974	40.019	40.064	1490	61.801	61.845	61.888	61.932	61.975	62.018	62.062	62.105	62.149	62.192	62.236

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F

Type E Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit																							
°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
1500	62.236	62.279	62.323	62.366	62.410	62.453	62.496	62.540	62.583	62.627	62.670	1700	70.828	70.871	70.913	70.955	70.998	71.040	71.082	71.125	71.167	71.209	71.252
1510	62.670	62.714	62.757	62.800	62.844	62.887	62.931	62.974	63.017	63.061	63.104	1710	71.252	71.294	71.336	71.379	71.421	71.463	71.506	71.548	71.590	71.632	71.675
1520	63.104	63.148	63.191	63.234	63.278	63.321	63.364	63.408	63.451	63.494	63.538	1720	71.675	71.717	71.759	71.801	71.844	71.886	71.928	71.970	72.012	72.055	72.097
1530	63.538	63.581	63.624	63.668	63.711	63.754	63.798	63.841	63.884	63.927	63.971	1730	72.097	72.139	72.181	72.223	72.266	72.308	72.350	72.392	72.434	72.476	72.518
1540	63.971	64.014	64.057	64.101	64.144	64.187	64.230	64.274	64.317	64.360	64.403	1740	72.518	72.561	72.603	72.645	72.687	72.729	72.771	72.813	72.855	72.897	72.939
1550	64.403	64.447	64.490	64.533	64.576	64.619	64.663	64.706	64.749	64.792	64.835	1750	72.939	72.981	73.023	73.066	73.108	73.150	73.192	73.234	73.276	73.318	73.360
1560	64.835	64.879	64.922	64.965	65.008	65.051	65.094	65.138	65.181	65.224	65.267	1760	73.360	73.402	73.444	73.486	73.528	73.570	73.612	73.654	73.696	73.738	73.780
1570	65.267	65.310	65.353	65.396	65.440	65.483	65.526	65.569	65.612	65.655	65.698	1770	73.780	73.821	73.863	73.905	73.947	73.989	74.031	74.073	74.115	74.157	74.199
1580	65.698	65.741	65.784	65.827	65.871	65.914	65.957	66.000	66.043	66.086	66.129	1780	74.199	74.241	74.283	74.324	74.366	74.408	74.450	74.492	74.534	74.576	74.618
1590	66.129	66.172	66.215	66.258	66.301	66.344	66.387	66.430	66.473	66.516	66.559	1790	74.618	74.659	74.701	74.743	74.785	74.827	74.869	74.910	74.952	74.994	75.036
1600	66.559	66.602	66.645	66.688	66.731	66.774	66.817	66.860	66.903	66.946	66.989	1800	75.036	75.078	75.120	75.161	75.203	75.245	75.287	75.329	75.370	75.412	75.454
1610	66.989	67.031	67.074	67.117	67.160	67.203	67.246	67.289	67.332	67.375	67.418	1810	75.454	75.496	75.538	75.579	75.621	75.663	75.705	75.746	75.788	75.830	75.872
1620	67.418	67.460	67.503	67.546	67.589	67.632	67.675	67.718	67.760	67.803	67.846	1820	75.872	75.913	75.955	75.997	76.039	76.081	76.122	76.164	76.206	76.248	76.289
1630	67.846	67.889	67.932	67.974	68.017	68.060	68.103	68.146	68.188	68.231	68.274	1830	76.289	76.331	76.373								
1640	68.274	68.317	68.359	68.402	68.445	68.488	68.530	68.573	68.616	68.659	68.701												
1650	68.701	68.744	68.787	68.829	68.872	68.915	68.957	69.000	69.043	69.085	69.128												
1660	69.128	69.171	69.213	69.256	69.298	69.341	69.384	69.426	69.469	69.511	69.554												
1670	69.554	69.597	69.639	69.682	69.724	69.767	69.809	69.852	69.894	69.937	69.979												
1680	69.979	70.022	70.064	70.107	70.149	70.192	70.234	70.277	70.319	70.362	70.404												
1690	70.404	70.447	70.489	70.531	70.574	70.616	70.659	70.701	70.744	70.786	70.828												

Type J Thermocouples

E
9[illegible]

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F

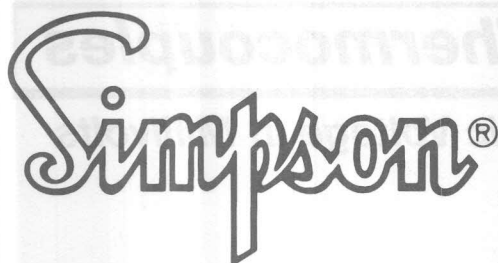


Type J Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit

°F	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°F	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
100	1.942	1.972	2.001	2.030	2.059	2.088	2.117	2.146	2.175	2.205	2.234	650	18.722	18.753	18.784	18.814	18.845	18.876	18.906	18.937	18.968	18.998	19.029
110	2.234	2.263	2.292	2.322	2.351	2.380	2.409	2.439	2.468	2.497	2.527	660	19.029	19.060	19.090	19.121	19.152	19.182	19.213	19.244	19.274	19.305	19.336
120	2.527	2.556	2.585	2.615	2.644	2.673	2.703	2.732	2.762	2.791	2.821	670	19.336	19.366	19.397	19.428	19.458	19.489	19.520	19.550	19.581	19.612	19.642
130	2.821	2.850	2.880	2.909	2.938	2.968	2.997	3.027	3.057	3.086	3.116	680	19.642	19.673	19.704	19.734	19.765	19.795	19.826	19.857	19.887	19.918	19.949
140	3.116	3.145	3.175	3.204	3.234	3.264	3.293	3.323	3.353	3.382	3.412	690	19.949	19.979	20.010	20.041	20.071	20.102	20.132	20.163	20.194	20.224	20.255
150	3.412	3.442	3.471	3.501	3.531	3.560	3.590	3.620	3.650	3.679	3.709	700	20.255	20.286	20.316	20.347	20.378	20.408	20.439	20.469	20.500	20.531	20.561
160	3.709	3.739	3.769	3.798	3.828	3.858	3.888	3.918	3.948	3.977	4.007	710	20.561	20.592	20.623	20.653	20.684	20.715	20.745	20.776	20.806	20.837	20.868
170	4.007	4.037	4.067	4.097	4.127	4.157	4.187	4.217	4.246	4.276	4.306	720	20.868	20.898	20.929	20.960	20.990	21.021	21.052	21.082	21.113	21.143	21.174
180	4.306	4.336	4.366	4.396	4.426	4.456	4.486	4.516	4.546	4.576	4.606	730	21.174	21.205	21.235	21.266	21.297	21.327	21.358	21.389	21.419	21.450	21.480
190	4.606	4.636	4.666	4.696	4.726	4.757	4.787	4.817	4.847	4.877	4.907	740	21.480	21.511	21.542	21.572	21.603	21.634	21.664	21.695	21.726	21.756	21.787
200	4.907	4.937	4.967	4.997	5.028	5.058	5.088	5.118	5.148	5.178	5.209	750	21.787	21.817	21.848	21.879	21.909	21.940	21.971	22.001	22.032	22.063	22.093
210	5.209	5.239	5.269	5.299	5.329	5.360	5.390	5.420	5.450	5.480	5.511	760	22.093	22.124	22.154	22.185	22.216	22.246	22.277	22.308	22.338	22.369	22.400
220	5.511	5.541	5.571	5.602	5.632	5.662	5.692	5.723	5.753	5.783	5.814	770	22.400	22.430	22.461	22.492	22.522	22.553	22.584	22.614	22.645	22.676	22.706
230	5.814	5.844	5.874	5.905	5.935	5.965	5.996	6.026	6.056	6.087	6.117	780	22.706	22.737	22.768	22.798	22.829	22.860	22.890	22.921	22.952	22.982	23.013
240	6.117	6.147	6.178	6.208	6.239	6.269	6.299	6.330	6.360	6.391	6.421	790	23.013	23.044	23.074	23.105	23.136	23.166	23.197	23.228	23.258	23.289	23.320
250	6.421	6.452	6.482	6.512	6.543	6.573	6.604	6.634	6.665	6.695	6.726	800	23.320	23.350	23.381	23.412	23.442	23.473	23.504	23.535	23.565	23.596	23.627
260	6.726	6.756	6.787	6.817	6.848	6.878	6.909	6.939	6.970	7.000	7.031	810	23.627	23.657	23.688	23.719	23.749	23.780	23.811	23.842	23.872	23.903	23.934
270	7.031	7.061	7.092	7.122	7.153	7.184	7.214	7.245	7.275	7.306	7.336	820	23.934	23.964	23.995	24.026	24.057	24.087	24.118	24.149	24.180	24.210	24.241
280	7.336	7.367	7.398	7.428	7.459	7.489	7.520	7.550	7.581	7.612	7.642	830	24.241	24.272	24.303	24.333	24.364	24.395	24.426	24.456	24.487	24.518	24.549
290	7.642	7.673	7.704	7.734	7.765	7.795	7.826	7.857	7.887	7.918	7.949	840	24.549	24.579	24.610	24.641	24.672	24.702	24.733	24.764	24.795	24.826	24.856
300	7.949	7.979	8.010	8.041	8.071	8.102	8.133	8.163	8.194	8.225	8.255	850	24.856	24.887	24.918	24.949	24.979	25.010	25.041	25.072	25.103	25.134	25.164
310	8.255	8.286	8.317	8.347	8.378	8.409	8.439	8.470	8.501	8.532	8.562	860	25.164	25.195	25.226	25.257	25.288	25.318	25.349	25.380	25.411	25.442	25.473
320	8.562	8.593	8.624	8.654	8.685	8.716	8.747	8.777	8.808	8.839	8.869	870	25.473	25.504	25.534	25.565	25.596	25.627	25.658	25.689	25.720	25.750	25.781
330	8.869	8.900	8.931	8.962	8.992	9.023	9.054	9.085	9.115	9.146	9.177	880	25.781	25.812	25.843	25.874	25.905	25.936	25.967	25.998	26.028	26.059	26.090
340	9.177	9.208	9.238	9.269	9.300	9.331	9.362	9.392	9.423	9.454	9.485	890	26.090	26.121	26.152	26.183	26.214	26.245	26.276	26.307	26.338	26.369	26.400
350	9.485	9.515	9.546	9.577	9.608	9.639	9.669	9.700	9.731	9.762	9.793	900	26.400	26.431	26.462	26.493	26.524	26.555	26.586	26.617	26.648	26.679	26.710
360	9.793	9.823	9.854	9.885	9.916	9.947	9.977	10.008	10.039	10.070	10.101	910	26.710	26.741	26.772	26.803	26.834	26.865	26.896	26.927	26.958	26.989	27.020
370	10.101	10.131	10.162	10.193	10.224	10.255	10.285	10.316	10.347	10.378	10.409	920	27.020	27.051	27.082	27.113	27.144	27.175	27.206	27.237	27.268	27.299	27.330
380	10.409	10.440	10.470	10.501	10.532	10.563	10.594	10.625	10.655	10.686	10.717	930	27.330	27.362	27.393	27.424	27.455	27.486	27.517	27.548	27.579	27.610	27.640
390	10.717	10.748	10.779	10.810	10.840	10.871	10.902	10.933	10.964	10.995	11.025	940	27.642	27.673	27.704	27.735	27.766	27.797	27.828	27.859	27.890	27.921	27.952
400	11.025	11.056	11.087	11.118	11.149	11.180	11.211	11.241	11.272	11.303	11.334	950	27.953	27.985	28.016	28.047	28.078	28.109	28.141	28.172	28.203	28.234	28.266
410	11.334	11.365	11.396	11.426	11.457	11.488	11.519	11.550	11.581	11.612	11.642	960	28.266	28.297	28.328	28.359	28.391	28.422	28.453	28.485	28.516	28.547	28.579
420	11.642	11.673	11.704	11.735	11.766	11.797	11.828	11.858	11.889	11.920	11.951	970	28.579	28.610	28.641	28.672	28.704	28.735	28.767	28.798	28.829	28.861	28.892
430	11.951	11.982	12.013	12.044	12.074	12.105	12.136	12.167	12.198	12.229	12.260	980	28.892	28.923	28.955	28.986	29.018	29.049	29.080	29.112	29.143	29.175	29.206
440	12.260	12.290	12.321	12.352	12.383	12.414	12.445	12.476	12.506	12.537	12.568	990	29.206	29.238	29.269	29.301	29.332	29.363	29.395	29.426	29.458	29.489	29.521
450	12.568	12.599	12.630	12.661	12.691	12.722	12.753	12.784	12.815	12.846	12.877	1000	29.521	29.552	29.584	29.616	29.647	29.679	29.710	29.742	29.773	29.805	29.836
460	12.877	12.907	12.938	12.969	13.000	13.031	13.062	13.093	13.123	13.154	13.185	1010	29.836	29.868	29.900	29.931	29.963	29.995	30.026	30.058	30.089	30.121	30.153
470	13.185	13.216	13.247	13.278	13.308	13.339	13.370	13.401	13.432	13.463	13.494	1020	30.153	30.184	30.216	30.248	30.279	30.311	30.343	30.375	30.406	30.438	30.470
480	13.494	13.524	13.555	13.586	13.617	13.648	13.679	13.709	13.740	13.771	13.802	1030	30.470	30.502	30.533	30.565	30.597	30.629	30.660	30.692	30.724	30.756	30.788
490	13.802	13.833	13.864	13.894	13.925	13.956	13.987	14.018	14.049	14.079	14.110	1040	30.788	30.819	30.851	30.883	30.915	30.947	30.979	31.011	31.043	31.074	31.106
500	14.110	14.141	14.172	14.203	14.233	14.264	14.295	14.326	14.357	14.388	14.418	1050	31.106	31.138	31.170	31.202	31.234	31.266	31.298	31.330	31.362	31.394	31.426
510	14.418	14.449	14.480	14.511	14.542	14.573	14.603	14.634	14.665	14.696	14.727	1060	31.426	31.458	31.490	31.522	31.554	31.586	31.618	31.650	31.682	31.714	31.746
520	14.727	14.757	14.788	14.819	14.850	14.881	14.911	14.942	14.973	15.004	15.035	1070	31.746	31.778	31.811	31.843	31.875	31.907	31.939	31.971	32.003	32.035	32.068
530	15.035	15.065	15.096	15.127	15.158	15.189	15.219	15.250	15.281	15.312	15.343	1080	32.068	32.100	32.132	32.164	32.196	32.229	32.261	32.293	32.325	32.358	32.390
540	15.343	15.373	15.404	15.435	15.466	15.496	15.527	15.558	15.589	15.620	15.650	1090	32.390	32.422	32.455	32.487	32.519	32.551	32.584	32.616	32.648	32.681	32.713
550	15.650	15.681	15.712	15.743	15.773	15.804	15.835	15.866	15.897	15.927	15.958	1100	32.713	32.746	32.778	32.810	32.843	32.875	32.908	32.940	32.973	33.005	33.037
560	15.958	15.989	16.020	16.050	16.081	16.112	16.143	16.173	16.204	16.235	16.266	1110	33.037	33.070	33.102	33.135	33.167	33.200	33.232				



Type J Thermocouples

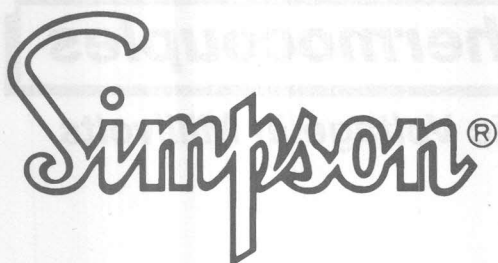
Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit

°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
1200	36.004	36.037	36.071	36.104	36.138	36.171	36.205	36.238	36.272	36.305	36.339	1700	53.530	53.564	53.598	53.632	53.667	53.701	53.735	53.769	53.803	53.837	53.871
1210	36.339	36.373	36.406	36.440	36.473	36.507	36.541	36.574	36.608	36.642	36.675	1710	53.871	53.905	53.939	53.973	54.007	54.041	54.075	54.109	54.143	54.177	54.211
1220	36.675	36.709	36.743	36.777	36.810	36.844	36.878	36.912	36.945	36.979	37.013	1720	54.211	54.245	54.279	54.313	54.347	54.381	54.415	54.449	54.483	54.516	54.550
1230	37.013	37.047	37.081	37.114	37.148	37.182	37.216	37.250	37.284	37.318	37.352	1730	54.550	54.584	54.618	54.652	54.686	54.719	54.753	54.787	54.821	54.855	54.888
1240	37.352	37.386	37.420	37.454	37.488	37.522	37.556	37.590	37.624	37.658	37.692	1740	54.888	54.922	54.956	54.990	55.023	55.057	55.091	55.124	55.158	55.192	55.225
1250	37.692	37.726	37.760	37.794	37.828	37.862	37.896	37.930	37.964	37.999	38.033	1750	55.225	55.259	55.293	55.326	55.360	55.393	55.427	55.461	55.494	55.528	55.561
1260	38.033	38.067	38.101	38.135	38.169	38.204	38.238	38.272	38.306	38.341	38.375	1760	55.561	55.595	55.628	55.662	55.695	55.729	55.762	55.796	55.829	55.863	55.896
1270	38.375	38.409	38.444	38.478	38.512	38.546	38.581	38.615	38.650	38.684	38.718	1770	55.896	55.930	55.963	55.997	56.030	56.063	56.097	56.130	56.164	56.197	56.230
1280	38.718	38.753	38.787	38.822	38.856	38.890	38.925	38.959	38.994	39.028	39.063	1780	56.230	56.264	56.297	56.330	56.364	56.397	56.430	56.464	56.497	56.530	56.564
1290	39.063	39.097	39.132	39.166	39.201	39.235	39.270	39.305	39.339	39.374	39.408	1790	56.564	56.597	56.630	56.663	56.697	56.730	56.763	56.796	56.829	56.863	56.896
1300	39.408	39.443	39.478	39.512	39.547	39.582	39.616	39.651	39.686	39.720	39.755	1800	56.896	56.929	56.962	56.995	57.028	57.062	57.095	57.128	57.161	57.194	57.227
1310	39.755	39.790	39.825	39.859	39.894	39.929	39.964	39.998	40.033	40.068	40.103	1810	57.227	57.260	57.293	57.326	57.360	57.393	57.426	57.459	57.492	57.525	57.558
1320	40.103	40.138	40.173	40.207	40.242	40.277	40.312	40.347	40.382	40.417	40.452	1820	57.558	57.591	57.624	57.657	57.690	57.723	57.756	57.789	57.822	57.855	57.888
1330	40.452	40.487	40.522	40.556	40.591	40.626	40.661	40.696	40.731	40.766	40.801	1830	57.888	57.920	57.953	57.986	58.019	58.052	58.085	58.118	58.151	58.184	58.217
1340	40.801	40.836	40.872	40.907	40.942	40.977	41.012	41.047	41.082	41.117	41.152	1840	58.217	58.249	58.282	58.315	58.348	58.381	58.414	58.446	58.479	58.512	58.545
1350	41.152	41.187	41.222	41.258	41.293	41.328	41.363	41.398	41.433	41.469	41.504	1850	58.545	58.578	58.610	58.643	58.676	58.709	58.741	58.774	58.807	58.840	58.872
1360	41.504	41.539	41.574	41.610	41.645	41.680	41.715	41.751	41.786	41.821	41.856	1860	58.872	58.905	58.938	58.971	59.003	59.036	59.069	59.101	59.134	59.167	59.199
1370	41.856	41.892	41.927	41.962	41.998	42.033	42.068	42.104	42.139	42.174	42.210	1870	59.199	59.232	59.265	59.297	59.330	59.363	59.395	59.428	59.460	59.493	59.526
1380	42.210	42.245	42.281	42.316	42.351	42.387	42.422	42.458	42.493	42.528	42.564	1880	59.526	59.558	59.591	59.623	59.656	59.689	59.721	59.754	59.786	59.819	59.851
1390	42.564	42.599	42.635	42.670	42.706	42.741	42.777	42.812	42.848	42.883	42.919	1890	59.851	59.884	59.916	59.949	59.982	60.014	60.047	60.079	60.112	60.144	60.177
1400	42.919	42.954	42.990	43.025	43.061	43.096	43.132	43.167	43.203	43.239	43.274	1900	60.177	60.209	60.242	60.274	60.307	60.339	60.371	60.404	60.436	60.469	60.501
1410	43.274	43.310	43.346	43.381	43.417	43.452	43.488	43.524	43.559	43.595	43.631	1910	60.501	60.534	60.566	60.599	60.631	60.663	60.696	60.728	60.761	60.793	60.826
1420	43.631	43.667	43.702	43.738	43.774	43.809	43.845	43.881	43.917	43.953	43.988	1920	60.826	60.858	60.890	60.923	60.955	60.987	61.020	61.052	61.085	61.117	61.149
1430	43.988	44.024	44.060	44.096	44.131	44.167	44.203	44.239	44.275	44.310	44.346	1930	61.149	61.182	61.214	61.246	61.279	61.311	61.343	61.376	61.408	61.440	61.473
1440	44.346	44.382	44.418	44.454	44.490	44.525	44.561	44.597	44.633	44.669	44.705	1940	61.473	61.505	61.537	61.570	61.602	61.634	61.667	61.699	61.731	61.763	61.796
1450	44.705	44.741	44.777	44.812	44.848	44.884	44.920	44.956	44.992	45.028	45.064	1950	61.796	61.828	61.860	61.893	61.925	61.957	61.989	62.022	62.054	62.086	62.118
1460	45.064	45.099	45.135	45.171	45.207	45.243	45.279	45.315	45.351	45.387	45.423	1960	62.118	62.151	62.183	62.215	62.247	62.280	62.312	62.344	62.376	62.409	62.441
1470	45.423	45.458	45.494	45.530	45.566	45.602	45.638	45.674	45.710	45.746	45.782	1970	62.441	62.473	62.505	62.537	62.570	62.602	62.634	62.666	62.699	62.731	62.763
1480	45.782	45.818	45.853	45.889	45.925	45.961	45.997	46.033	46.069	46.105	46.141	1980	62.763	62.795	62.827	62.860	62.892	62.924	62.956	62.988	63.020	63.053	63.085
1490	46.141	46.177	46.212	46.248	46.284	46.320	46.356	46.392	46.428	46.464	46.500	1990	63.085	63.117	63.149	63.181	63.214	63.246	63.278	63.310	63.342	63.374	63.406
1500	46.500	46.535	46.571	46.607	46.643	46.679	46.715	46.751	46.786	46.822	46.858	2000	63.406	63.439	63.471	63.503	63.535	63.567	63.599	63.632	63.664	63.696	63.728
1510	46.858	46.894	46.930	46.966	47.001	47.037	47.073	47.109	47.145	47.181	47.216	2010	63.728	63.760	63.792	63.824	63.856	63.889	63.921	63.953	63.985	64.017	64.049
1520	47.216	47.252	47.288	47.324	47.359	47.395	47.431	47.467	47.503	47.538	47.574	2020	64.049	64.081	64.113	64.146	64.178	64.210	64.242	64.274	64.306	64.338	64.370
1530	47.574	47.610	47.646	47.681	47.717	47.753	47.788	47.824	47.860	47.896	47.931	2030	64.370	64.402	64.435	64.467	64.499	64.531	64.563	64.595	64.627	64.659	64.691
1540	47.931	47.967	48.003	48.038	48.074	48.110	48.145	48.181	48.217	48.252	48.288	2040	64.691	64.723	64.756	64.788	64.820	64.852	64.884	64.916	64.948	64.980	65.012
1550	48.288	48.324	48.359	48.395	48.430	48.466	48.502	48.537	48.573	48.608	48.644	2050	65.012	65.044	65.076	65.109	65.141	65.173	65.205	65.237	65.269	65.301	65.333
1560	48.644	48.679	48.715	48.750	48.786	48.822	48.857	48.893	48.928	48.964	48.999	2060	65.333	65.365	65.397	65.429	65.461	65.493	65.525	65.557	65.590	65.622	65.654
1570	48.999	49.034	49.070	49.105	49.141	49.176	49.212	49.247	49.283	49.318	49.353	2070	65.654	65.686	65.718	65.750	65.782	65.814	65.846	65.878	65.910	65.942	65.974
1580	49.353	49.389	49.424	49.460	49.495	49.530	49.566	49.601	49.636	49.672	49.707	2080	65.974	66.006	66.038	66.070	66.102	66.134	66.166	66.199	66.231	66.263	66.295
1590	49.707	49.742	49.778	49.813	49.848	49.883	49.919	49.954	49.989	50.024	50.060	2090	66.295	66.327	66.359	66.391	66.423	66.455	66.487	66.519	66.551	66.583	66.615
1600	50.060	50.095	50.130	50.165	50.200	50.235	50.271	50.306	50.341	50.376	50.411	2100	66.615	66.647	66.679	66.711	66.743	66.775	66.807	66.839	66.871	66.903	66.935
1610	50.411	50.446	50.481	50.517	50.552	50.587	50.622	50.657	50.692	50.727	50.762	2110	66.935	66.967	66.999	67.031	67.063	67.095	67.127	67.159	67.191	67.223	67.255
1620	50.762	50.797	50.832	50.867	50.902	50.937	50.972	51.007	51.042	51.077	51.112	2120	67.255	67.287	67.319	67.351	67.383	67.415	67.447	67.479	67.511	67.543	67.575
1630	51.112	51.147	51.181	51.216	51.251	51.286	51.321	51.356	51.391	51.425	51.460	2130	67.575	67.607	67.639	67.671	67.703	67.735	67.767	67.799	67.831	67.863	67.895
1640	51.460	51.495	51.530	51.565	51.599	51.634	51.669	51.704	51.738	51.773	51.808	2140	67.895	67.927	67.959	67.991	68.023	68.055	68.087	68.119	68.150	68.182	68.214
1650	51.808	51.843	51.877	51.912	51.947	51.981	52.016	52.051	52.085	52.120	52.154	2150	68.214	68.246	68.278								

-440	-6.446	-6.448	-6.449	-6.450	-6.451	-6.452	-6.453	-6.454	-6.454	-6.455	-6.456	50	0.397	0.419	0.441	0.463	0.486	0.508	0.530	0.552	0.575	0.597	0.619
-430	-6.431	-6.433	-6.435	-6.436	-6.438	-6.440	-6.441	-6.443	-6.444	-6.445	-6.446	60	0.619	0.642	0.664	0.686	0.709	0.731	0.753	0.776	0.798	0.821	0.843
-420	-6.409	-6.411	-6.414	-6.416	-6.419	-6.421	-6.423	-6.425	-6.427	-6.429	-6.431	70	0.843	0.865	0.888	0.910	0.933	0.955	0.978	1.000	1.023	1.045	1.068
-410	-6.380	-6.383	-6.386	-6.389	-6.392	-6.395	-6.398	-6.401	-6.404	-6.406	-6.409	80	1.068	1.090	1.113	1.136	1.158	1.181	1.203	1.226	1.249	1.271	1.294
-400	-6.344	-6.348	-6.352	-6.355	-6.359	-6.363	-6.366	-6.370	-6.373	-6.377	-6.380	90	1.294	1.316	1.339	1.362	1.384	1.407	1.430	1.453	1.475	1.498	1.521
-390	-6.301	-6.306	-6.310	-6.315	-6.319	-6.323	-6.328	-6.332	-6.336	-6.340	-6.344	100	1.521	1.543	1.566	1.589	1.612	1.635	1.657	1.680	1.703	1.726	1.749
-380	-6.251	-6.257	-6.262	-6.267	-6.272	-6.277	-6.282	-6.287	-6.292	-6.296	-6.301	110	1.749	1.771	1.794	1.817	1.840	1.863	1.886	1.909	1.931	1.954	1.977
-370	-6.195	-6.201	-6.207	-6.213	-6.218	-6.224	-6.230	-6.235	-6.241	-6.246	-6.251	120	1.977	2.000	2.023	2.046	2.069	2.092	2.115	2.138	2.161	2.184	2.207
-360	-6.133	-6.139	-6.146	-6.152	-6.158	-6.164	-6.171	-6.177	-6.183	-6.189	-6.195	130	2.207	2.230	2.253	2.276	2.298	2.321	2.344	2.367	2.390	2.413	2.436
-350	-6.064	-6.071	-6.078	-6.085	-6.092	-6.099	-6.106	-6.113	-6.119	-6.126	-6.133	140	2.436	2.459	2.483	2.506	2.529	2.552	2.575	2.598	2.621	2.644	2.667
-340	-5.989	-5.997	-6.004	-6.012	-6.020	-6.027	-6.035	-6.042	-6.049	-6.057	-6.064	150	2.667	2.690	2.713	2.736	2.759	2.782	2.805	2.828	2.851	2.874	2.897
-330	-5.908	-5.917	-5.925	-5.933	-5.941	-5.949	-5.957	-5.965	-5.973	-5.981	-5.989	160	2.897	2.920	2.944	2.967	2.990	3.013	3.036	3.059	3.082	3.105	3.128
-320	-5.822	-5.831	-5.840	-5.848	-5.857	-5.866	-5.874	-5.883	-5.891	-5.900	-5.908	170	3.128	3.151	3.174	3.197	3.220	3.244	3.267	3.290	3.313	3.336	3.359
-310	-5.730	-5.739	-5.749	-5.758	-5.767	-5.776	-5.786	-5.795	-5.804	-5.813	-5.822	180	3.359	3.382	3.405	3.428	3.451	3.474	3.497	3.520	3.544	3.567	3.590
-300	-5.652	-5.642	-5.652	-5.662	-5.672	-5.682	-5.691	-5.701	-5.711	-5.720	-5.730	190	3.590	3.613	3.636	3.659	3.682	3.705	3.728	3.751	3.774	3.797	3.820
-290	-5.529	-5.540	-5.550	-5.561	-5.571	-5.581	-5.592	-5.602	-5.612	-5.622	-5.632	200	3.820	3.843	3.866	3.889	3.912	3.935	3.958	3.981	4.004	4.027	4.050
-280	-5.421	-5.432	-5.443	-5.454	-5.465	-5.476	-5.487	-5.497	-5.508	-5.519	-5.529	210	4.050	4.073	4.096	4.119	4.142	4.165	4.188	4.211	4.234	4.257	4.280
-270	-5.308	-5.320	-5.331	-5.343	-5.354	-5.365	-5.377	-5.388	-5.399	-5.410	-5.421	220	4.280	4.303	4.326	4.349	4.372	4.395	4.417	4.440	4.463	4.486	4.509
-260	-5.190	-5.202	-5.214	-5.226	-5.238	-5.250	-5.261	-5.273	-5.285	-5.296	-5.308	230	4.509	4.532	4.555	4.578	4.601	4.623	4.646	4.669	4.692	4.715	4.738
-250	-5.067	-5.079	-5.092	-5.104	-5.117	-5.129	-5.141	-5.153	-5.166	-5.178	-5.190	240	4.738	4.760	4.783	4.806	4.829	4.852	4.874	4.897	4.920	4.943	4.965
-240	-4.939	-4.952	-4.965	-4.978	-4.991	-5.003	-5.016	-5.029	-5.042	-5.054	-5.067	250	4.965	4.988	5.011	5.034	5.056	5.079	5.102	5.124	5.147	5.170	5.192
-230	-4.806	-4.820	-4.833	-4.847	-4.860	-4.873	-4.886	-4.900	-4.913	-4.926	-4.939	260	5.192	5.215	5.238	5.260	5.283	5.306	5.328	5.351	5.374	5.396	5.419
-220	-4.669	-4.683	-4.697	-4.711	-4.724	-4.738	-4.752	-4.766	-4.779	-4.793	-4.806	270	5.419	5.441	5.464	5.487	5.509	5.532	5.554	5.577	5.599	5.622	5.644
-210	-4.527	-4.542	-4.556	-4.570	-4.584	-4.599	-4.613	-4.627	-4.641	-4.655	-4.669	280	5.644	5.667	5.690	5.712	5.735	5.757	5.779	5.802	5.824	5.847	5.869
-200	-4.381	-4.396	-4.411	-4.425	-4.440	-4.455	-4.469	-4.484	-4.498	-4.513	-4.527	290	5.869	5.892	5.914	5.937	5.959	5.982	6.004	6.026	6.049	6.071	6.094
-190	-4.231	-4.246	-4.261	-4.276	-4.291	-4.306	-4.321	-4.336	-4.351	-4.366	-4.381	300	6.094	6.116	6.138	6.161	6.183	6.205	6.228	6.250	6.272	6.295	6.317
-180	-4.076	-4.091	-4.107	-4.123	-4.138	-4.154	-4.169	-4.185	-4.200	-4.215	-4.231	310	6.317	6.339	6.362	6.384	6.406	6.429	6.451	6.473	6.496	6.518	6.540
-170	-3.917	-3.933	-3.949	-3.965	-3.981	-3.997	-4.013	-4.029	-4.044	-4.060	-4.076	320	6.540	6.562	6.585	6.607	6.629	6.652	6.674	6.696	6.718	6.741	6.763
-160	-3.754	-3.771	-3.787	-3.803	-3.820	-3.836	-3.852	-3.869	-3.885	-3.901	-3.917	330	6.763	6.785	6.807	6.829	6.852	6.874	6.896	6.918	6.941	6.963	6.985
-150	-3.587	-3.604	-3.621	-3.638	-3.655	-3.671	-3.688	-3.705	-3.721	-3.738	-3.754	340	6.985	7.007	7.029	7.052	7.074	7.096	7.118	7.140	7.163	7.185	7.207
-140	-3.417	-3.434	-3.451	-3.468	-3.486	-3.503	-3.520	-3.537	-3.554	-3.571	-3.587	350	7.207	7.229	7.251	7.273	7.296	7.318	7.340	7.362	7.384	7.407	7.429
-130	-3.243	-3.260	-3.278	-3.295	-3.313	-3.330	-3.348	-3.365	-3.382	-3.400	-3.417	360	7.429	7.451	7.473	7.495	7.517	7.540	7.562	7.584	7.606	7.628	7.650
-120	-3.065	-3.083	-3.101	-3.119	-3.136	-3.154	-3.172	-3.190	-3.207	-3.225	-3.243	370	7.650	7.673	7.695	7.717	7.739	7.761	7.783	7.806	7.828	7.850	7.872
-110	-2.884	-2.902	-2.920	-2.938	-2.957	-2.975	-2.993	-3.011	-3.029	-3.047	-3.065	380	7.872	7.894	7.917	7.939	7.961	7.983	8.005	8.027	8.050	8.072	8.094
-100	-2.699	-2.718	-2.736	-2.755	-2.773	-2.792	-2.810	-2.829	-2.847	-2.865	-2.884	390	8.094	8.116	8.138	8.161	8.183	8.205	8.227	8.250	8.272	8.294	8.316
-90	-2.511	-2.530	-2.549	-2.568	-2.587	-2.605	-2.624	-2.643	-2.662	-2.680	-2.699	400	8.316	8.338	8.361	8.383	8.405	8.427	8.450	8.472	8.494	8.516	8.539
-80	-2.320	-2.339	-2.359	-2.378	-2.397	-2.416	-2.435	-2.454	-2.473	-2.492	-2.511	410	8.539	8.561	8.583	8.605	8.628	8.650	8.672	8.694	8.717	8.739	8.761
-70	-2.126	-2.146	-2.165	-2.185	-2.204	-2.223	-2.243	-2.262	-2.282	-2.301	-2.320	420	8.761	8.784	8.806	8.828	8.851	8.873	8.895	8.918	8.940	8.962	8.985
-60	-1.929	-1.949	-1.969	-1.988	-2.008	-2.028	-2.048	-2.067	-2.087	-2.106	-2.126	430	8.985	9.007	9.029	9.052	9.074	9.096	9.119	9.141	9.163	9.186	9.208
-50	-1.729	-1.749	-1.770	-1.790	-1.810	-1.830	-1.850	-1.869	-1.889	-1.909	-1.929	440	9.208	9.231	9.253	9.275	9.298	9.320	9.343	9.365	9.388	9.410	9.432
-40	-1.527	-1.547	-1.568	-1.588	-1.608	-1.628	-1.649	-1.669	-1.689	-1.709	-1.729	450	9.432	9.455	9.477	9.500	9.522	9.545	9.567	9.590	9.612	9.635	9.657
-30	-1.322	-1.343	-1.363	-1.384	-1.404	-1.425	-1.445	-1.466	-1.486	-1.507	-1.527	460	9.657	9.680	9.702	9.725	9.747	9.770	9.792	9.815	9.837	9.860	9.882
-20	-1.114	-1.135	-1.156	-1.177	-1.198	-1.218	-1.239	-1.260	-1.281	-1.301	-1.322	470	9.882	9.905	9.927	9.950	9.973	9.995	10.018	10.040	10.063	10.086	10.108
-10	-0.905	-0.926	-0.947	-0.968	-0.989	-1.010	-1.031	-1.052	-1.073	-1.094	-1.114	480	10.108	10.131	10.153	10.176	10.199	10.221	10.244	10.267	10.289	10.312	10.334
0	-0.692	-0.714	-0.735	-0.756	-0.778	-0.799	-0.820	-0.841	-0.862	-0.883	-0.905	490	10.334	10.357	10.380	10.402	10.425	10.448	10.471	10.493	10.516	10.539	10.561

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F



Type K Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit																							
°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
500	10.561	10.584	10.607	10.629	10.652	10.675	10.698	10.720	10.743	10.766	10.789	1000	22.255	22.279	22.303	22.326	22.350	22.374	22.397	22.421	22.445	22.468	22.492
510	10.789	10.811	10.834	10.857	10.880	10.903	10.925	10.948	10.971	10.994	11.017	1010	22.492	22.516	22.540	22.563	22.587	22.611	22.634	22.658	22.682	22.705	22.729
520	11.017	11.039	11.062	11.085	11.108	11.131	11.154	11.176	11.199	11.222	11.245	1020	22.729	22.753	22.776	22.800	22.824	22.847	22.871	22.895	22.919	22.942	22.966
530	11.245	11.268	11.291	11.313	11.336	11.359	11.382	11.405	11.428	11.451	11.474	1030	22.966	22.990	23.013	23.037	23.061	23.084	23.108	23.132	23.155	23.179	23.203
540	11.474	11.497	11.519	11.542	11.565	11.588	11.611	11.634	11.657	11.680	11.703	1040	23.203	23.226	23.250	23.274	23.297	23.321	23.345	23.368	23.392	23.416	23.439
550	11.703	11.726	11.749	11.772	11.795	11.818	11.841	11.864	11.887	11.910	11.933	1050	23.439	23.463	23.487	23.510	23.534	23.558	23.581	23.605	23.629	23.652	23.676
560	11.933	11.956	11.978	12.001	12.024	12.047	12.070	12.093	12.116	12.140	12.163	1060	23.676	23.700	23.723	23.747	23.771	23.794	23.818	23.842	23.865	23.889	23.913
570	12.163	12.186	12.209	12.232	12.255	12.278	12.301	12.324	12.347	12.370	12.393	1070	23.913	23.936	23.960	23.984	24.007	24.031	24.055	24.078	24.102	24.126	24.149
580	12.393	12.416	12.439	12.462	12.485	12.508	12.531	12.554	12.577	12.600	12.624	1080	24.149	24.173	24.197	24.220	24.244	24.267	24.291	24.315	24.338	24.362	24.386
590	12.624	12.647	12.670	12.693	12.716	12.739	12.762	12.785	12.808	12.831	12.855	1090	24.386	24.409	24.433	24.457	24.480	24.504	24.527	24.551	24.575	24.598	24.622
600	12.855	12.878	12.901	12.924	12.947	12.970	12.993	13.016	13.040	13.063	13.086	1100	24.622	24.646	24.669	24.693	24.717	24.740	24.764	24.787	24.811	24.835	24.858
610	13.086	13.109	13.132	13.155	13.179	13.202	13.225	13.248	13.271	13.294	13.318	1110	24.858	24.882	24.905	24.929	24.953	24.976	25.000	25.024	25.047	25.071	25.094
620	13.318	13.341	13.364	13.387	13.410	13.433	13.457	13.480	13.503	13.526	13.549	1120	25.094	25.118	25.142	25.165	25.189	25.212	25.236	25.260	25.283	25.307	25.330
630	13.549	13.573	13.596	13.619	13.642	13.665	13.689	13.712	13.735	13.758	13.782	1130	25.330	25.354	25.377	25.401	25.425	25.448	25.472	25.495	25.519	25.543	25.566
640	13.782	13.805	13.828	13.851	13.874	13.898	13.921	13.944	13.967	13.991	14.014	1140	25.566	25.590	25.613	25.637	25.660	25.684	25.708	25.731	25.755	25.778	25.802
650	14.014	14.037	14.060	14.084	14.107	14.130	14.154	14.177	14.200	14.223	14.247	1150	25.802	25.825	25.849	25.873	25.896	25.920	25.943	25.967	25.990	26.014	26.037
660	14.247	14.270	14.293	14.316	14.340	14.363	14.386	14.410	14.433	14.456	14.479	1160	26.037	26.061	26.084	26.108	26.132	26.155	26.179	26.202	26.226	26.249	26.273
670	14.479	14.503	14.526	14.549	14.573	14.596	14.619	14.643	14.666	14.689	14.713	1170	26.273	26.296	26.320	26.343	26.367	26.390	26.414	26.437	26.461	26.484	26.508
680	14.713	14.736	14.759	14.783	14.806	14.829	14.853	14.876	14.899	14.923	14.946	1180	26.508	26.532	26.555	26.579	26.602	26.626	26.649	26.673	26.696	26.720	26.743
690	14.946	14.969	14.993	15.016	15.039	15.063	15.086	15.109	15.133	15.156	15.179	1190	26.743	26.767	26.790	26.814	26.837	26.861	26.884	26.907	26.931	26.954	26.978
700	15.179	15.203	15.226	15.250	15.273	15.296	15.320	15.343	15.366	15.390	15.413	1200	26.978	27.001	27.025	27.048	27.072	27.095	27.119	27.142	27.166	27.189	27.213
710	15.413	15.437	15.460	15.483	15.507	15.530	15.554	15.577	15.600	15.624	15.647	1210	27.213	27.236	27.259	27.283	27.306	27.330	27.353	27.377	27.400	27.424	27.447
720	15.647	15.671	15.694	15.717	15.741	15.764	15.788	15.811	15.834	15.858	15.881	1220	27.447	27.471	27.494	27.517	27.541	27.564	27.588	27.611	27.635	27.658	27.681
730	15.881	15.905	15.928	15.952	15.975	15.998	16.022	16.045	16.069	16.092	16.116	1230	27.681	27.705	27.728	27.752	27.775	27.798	27.822	27.845	27.869	27.892	27.915
740	16.116	16.139	16.163	16.186	16.209	16.233	16.256	16.280	16.303	16.327	16.350	1240	27.915	27.939	27.962	27.986	28.009	28.032	28.056	28.079	28.103	28.126	28.149
750	16.350	16.374	16.397	16.421	16.444	16.468	16.491	16.514	16.538	16.561	16.585	1250	28.149	28.173	28.196	28.219	28.243	28.266	28.289	28.313	28.336	28.360	28.383
760	16.585	16.608	16.632	16.655	16.679	16.702	16.726	16.749	16.773	16.796	16.820	1260	28.383	28.406	28.430	28.453	28.476	28.500	28.523	28.546	28.570	28.593	28.616
770	16.820	16.843	16.867	16.890	16.914	16.937	16.961	16.984	17.008	17.031	17.055	1270	28.616	28.640	28.663	28.686	28.710	28.733	28.756	28.780	28.803	28.826	28.849
780	17.055	17.078	17.102	17.125	17.149	17.173	17.196	17.220	17.243	17.267	17.290	1280	28.849	28.873	28.896	28.919	28.943	28.966	28.989	29.013	29.036	29.059	29.082
790	17.290	17.314	17.337	17.361	17.384	17.408	17.431	17.455	17.478	17.502	17.526	1290	29.082	29.106	29.129	29.152	29.176	29.199	29.222	29.245	29.269	29.292	29.315
800	17.526	17.549	17.573	17.596	17.620	17.643	17.667	17.690	17.714	17.738	17.761	1300	29.315	29.338	29.362	29.385	29.408	29.431	29.455	29.478	29.501	29.524	29.548
810	17.761	17.785	17.808	17.832	17.855	17.879	17.902	17.926	17.950	17.973	17.997	1310	29.548	29.571	29.594	29.617	29.640	29.664	29.687	29.710	29.733	29.757	29.780
820	17.997	18.020	18.044	18.068	18.091	18.115	18.138	18.162	18.185	18.209	18.233	1320	29.780	29.803	29.826	29.849	29.873	29.896	29.919	29.942	29.965	29.989	30.012
830	18.233	18.256	18.280	18.303	18.327	18.351	18.374	18.398	18.421	18.445	18.469	1330	30.012	30.035	30.058	30.081	30.104	30.128	30.151	30.174	30.197	30.220	30.243
840	18.469	18.492	18.516	18.539	18.563	18.587	18.610	18.634	18.657	18.681	18.705	1340	30.243	30.267	30.290	30.313	30.336	30.359	30.382	30.405	30.429	30.452	30.475
850	18.705	18.728	18.752	18.776	18.799	18.823	18.846	18.870	18.894	18.917	18.941	1350	30.475	30.498	30.521	30.544	30.567	30.590	30.613	30.637	30.660	30.683	30.706
860	18.941	18.965	18.988	19.012	19.035	19.059	19.083	19.106	19.130	19.154	19.177	1360	30.706	30.729	30.752	30.775	30.798	30.821	30.844	30.868	30.891	30.914	30.937
870	19.177	19.201	19.224	19.248	19.272	19.295	19.319	19.343	19.366	19.390	19.414	1370	30.937	30.960	30.983	31.006	31.029	31.052	31.075	31.098	31.121	31.144	31.167
880	19.414	19.437	19.461	19.485	19																		



Type K Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit

°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
1500	33.912	33.935	33.957	33.980	34.003	34.025	34.048	34.071	34.093	34.116	34.139	2000	44.866	44.887	44.908	44.929	44.950	44.971	44.992	45.014	45.035	45.056	45.077
1510	34.139	34.161	34.184	34.207	34.229	34.252	34.275	34.297	34.320	34.343	34.365	2010	45.077	45.098	45.119	45.140	45.161	45.182	45.203	45.224	45.245	45.266	45.287
1520	34.365	34.388	34.410	34.433	34.456	34.478	34.501	34.524	34.546	34.569	34.591	2020	45.287	45.308	45.329	45.350	45.371	45.392	45.413	45.434	45.455	45.476	45.497
1530	34.591	34.614	34.637	34.659	34.682	34.704	34.727	34.750	34.772	34.795	34.817	2030	45.497	45.518	45.539	45.560	45.580	45.601	45.622	45.643	45.664	45.685	45.706
1540	34.817	34.840	34.862	34.885	34.908	34.930	34.953	34.975	34.998	35.020	35.043	2040	45.706	45.727	45.748	45.769	45.790	45.811	45.832	45.852	45.873	45.894	45.915
1550	35.043	35.065	35.088	35.110	35.133	35.156	35.178	35.201	35.223	35.246	35.268	2050	45.915	45.936	45.957	45.978	45.999	46.019	46.040	46.061	46.082	46.103	46.124
1560	35.268	35.291	35.313	35.336	35.358	35.381	35.403	35.426	35.448	35.471	35.493	2060	46.124	46.145	46.165	46.186	46.207	46.228	46.249	46.269	46.290	46.311	46.332
1570	35.493	35.516	35.538	35.560	35.583	35.605	35.628	35.650	35.673	35.695	35.718	2070	46.332	46.353	46.373	46.394	46.415	46.436	46.457	46.477	46.498	46.519	46.540
1580	35.718	35.740	35.763	35.785	35.807	35.830	35.852	35.875	35.897	35.920	35.942	2080	46.540	46.560	46.581	46.602	46.623	46.643	46.664	46.685	46.706	46.726	46.747
1590	35.942	35.964	35.987	36.009	36.032	36.054	36.076	36.099	36.121	36.144	36.166	2090	46.747	46.768	46.789	46.809	46.830	46.851	46.871	46.892	46.913	46.933	46.954
1600	36.166	36.188	36.211	36.233	36.256	36.278	36.300	36.323	36.345	36.367	36.390	2100	46.954	46.975	46.995	47.016	47.037	47.057	47.078	47.099	47.119	47.140	47.161
1610	36.390	36.412	36.434	36.457	36.479	36.501	36.524	36.546	36.568	36.591	36.613	2110	47.161	47.181	47.202	47.223	47.243	47.264	47.284	47.305	47.326	47.346	47.367
1620	36.613	36.635	36.658	36.680	36.702	36.725	36.747	36.769	36.792	36.814	36.836	2120	47.367	47.387	47.408	47.429	47.449	47.470	47.490	47.511	47.531	47.552	47.573
1630	36.836	36.859	36.881	36.903	36.925	36.948	36.970	36.992	37.014	37.037	37.059	2130	47.573	47.593	47.614	47.634	47.655	47.675	47.696	47.716	47.737	47.757	47.778
1640	37.059	37.081	37.104	37.126	37.148	37.170	37.193	37.215	37.237	37.259	37.281	2140	47.778	47.798	47.819	47.839	47.860	47.880	47.901	47.921	47.942	47.962	47.983
1650	37.281	37.304	37.326	37.348	37.370	37.393	37.415	37.437	37.459	37.481	37.504	2150	47.983	48.003	48.024	48.044	48.065	48.085	48.105	48.126	48.146	48.167	48.187
1660	37.504	37.526	37.548	37.570	37.592	37.615	37.637	37.659	37.681	37.703	37.725	2160	48.187	48.208	48.228	48.248	48.269	48.289	48.310	48.330	48.350	48.371	48.391
1670	37.725	37.748	37.770	37.792	37.814	37.836	37.858	37.881	37.903	37.925	37.947	2170	48.391	48.411	48.432	48.452	48.473	48.493	48.513	48.534	48.554	48.574	48.595
1680	37.947	37.969	37.991	38.013	38.036	38.058	38.080	38.102	38.124	38.146	38.168	2180	48.595	48.615	48.635	48.656	48.676	48.696	48.717	48.737	48.757	48.777	48.798
1690	38.168	38.190	38.212	38.235	38.257	38.279	38.301	38.323	38.345	38.367	38.389	2190	48.798	48.818	48.838	48.859	48.879	48.899	48.919	48.940	48.960	48.980	49.000
1700	38.389	38.411	38.433	38.455	38.477	38.499	38.522	38.544	38.566	38.588	38.610	2200	49.000	49.021	49.041	49.061	49.081	49.101	49.122	49.142	49.162	49.182	49.202
1710	38.610	38.632	38.654	38.676	38.698	38.720	38.742	38.764	38.786	38.808	38.830	2210	49.202	49.223	49.243	49.263	49.283	49.303	49.323	49.344	49.364	49.384	49.404
1720	38.830	38.852	38.874	38.896	38.918	38.940	38.962	38.984	39.006	39.028	39.050	2220	49.404	49.424	49.444	49.465	49.485	49.505	49.525	49.545	49.565	49.585	49.605
1730	39.050	39.072	39.094	39.116	39.138	39.160	39.182	39.204	39.226	39.248	39.270	2230	49.605	49.625	49.645	49.666	49.686	49.706	49.726	49.746	49.766	49.786	49.806
1740	39.270	39.292	39.314	39.335	39.357	39.379	39.401	39.423	39.445	39.467	39.489	2240	49.806	49.826	49.846	49.866	49.886	49.906	49.926	49.946	49.966	49.986	50.006
1750	39.489	39.511	39.533	39.555	39.577	39.599	39.620	39.642	39.664	39.686	39.708	2250	50.006	50.026	50.046	50.066	50.086	50.106	50.126	50.146	50.166	50.186	50.206
1760	39.708	39.730	39.752	39.774	39.796	39.817	39.839	39.861	39.883	39.905	39.927	2260	50.206	50.226	50.246	50.266	50.286	50.306	50.326	50.346	50.366	50.385	50.405
1770	39.927	39.949	39.970	39.992	40.014	40.036	40.058	40.080	40.101	40.123	40.145	2270	50.405	50.425	50.445	50.465	50.485	50.505	50.525	50.545	50.564	50.584	50.604
1780	40.145	40.167	40.189	40.211	40.232	40.254	40.276	40.298	40.320	40.341	40.363	2280	50.604	50.624	50.644	50.664	50.684	50.703	50.723	50.743	50.763	50.783	50.802
1790	40.363	40.385	40.407	40.429	40.450	40.472	40.494	40.516	40.537	40.559	40.581	2290	50.802	50.822	50.842	50.862	50.882	50.901	50.921	50.941	50.961	50.981	51.000
1800	40.581	40.603	40.624	40.646	40.668	40.690	40.711	40.733	40.755	40.777	40.798	2300	51.000	51.020	51.040	51.060	51.079	51.099	51.119	51.139	51.158	51.178	51.198
1810	40.798	40.820	40.842	40.864	40.885	40.907	40.929	40.950	40.972	40.994	41.015	2310	51.198	51.217	51.237	51.257	51.276	51.296	51.316	51.336	51.355	51.375	51.395
1820	41.015	41.037	41.059	41.081	41.102	41.124	41.146	41.167	41.189	41.211	41.232	2320	51.395	51.414	51.434	51.453	51.473	51.493	51.512	51.532	51.552	51.571	51.591
1830	41.232	41.254	41.276	41.297	41.319	41.341	41.362	41.384	41.405	41.427	41.449	2330	51.591	51.611	51.630	51.650	51.669	51.689	51.708	51.728	51.748	51.767	51.787
1840	41.449	41.470	41.492	41.514	41.535	41.557	41.578	41.600	41.622	41.643	41.665	2340	51.787	51.806	51.826	51.845	51.865	51.885	51.904	51.924	51.943	51.963	51.982
1850	41.665	41.686	41.708	41.730	41.751	41.773	41.794	41.816	41.838	41.859	41.881	2350	51.982	52.002	52.021	52.041	52.060	52.080	52.099	52.119	52.138	52.158	52.177
1860	41.881	41.902	41.924	41.945	41.967	41.988	42.010	42.032	42.053	42.075	42.096	2360	52.177	52.197	52.216	52.235	52.255	52.274	52.294	52.313	52.333	52.352	52.371
1870	42.096	42.118	42.139	42.161	42.182	42.204	42.225	42.247	42.268	42.290	42.311	2370	52.371	52.391	52.410	52.430	52.449	52.468	52.488	52.507	52.527	52.546	52.565
1880	42.311	42.333	42.354	42.376	42.397	42.419	42.440	42.462	42.483	42.505	42.526	2380	52.565	52.585	52.604	52.623	52.643	52.662	52.681	52.701	52.720	52.739	52.759
1890	42.526	42.548	42.569	42.591	42.612	42.633	42.655	42.676	42.698	42.719	42.741	2390	52.759	52.778	52.797	52.817	52.836	52.855	52.875	52.894	52.913	52.932	52.952
1900	42.741	42.762	42.783	42.805	42.826	42.848	42.869	42.891	42.912	42.933	42.955	2400	52.952	52.971	52.990	53.010	53.029	53.048	53.067	53.087	53.106	53.125	53.144
1910	42.955	42.976	42.998	43.019	43.040	43.062	43.083	43.104	43.126	43.147	43.169	2410	53.144	53.163	53.183	53.202	53.221	53.240	53.260	53.279	53.298	53.317	53.336
1920	43.169	43.190	43.211	43.233	43.254	43.275	43.297	43.318	43.339	43.361	43.382	2420	53.336	53.355	53.375	53.394	53.413	53.432	53.451	53.470	53.490	53.509	53.528
1930	43.382	43.403	43.425	43.446	43.467	43.489	43.510	43.531	43.552	43.574	43.595	2430	53.528	53.547	53.566	53.585	53.604	53.623	53.643	53.662	53.681	53.700	53.719
1940	43.595	43.616	43.638	43.659	43.680	43.701	43.723	43.744	43.765	43.787	43.808	2440	53.719	53.738	53.757	53.776	53.795	53.814	53.833	53.852	53.871	53.890	53.910
1950	43.808	43.829	43.850	43.872	43.893	43.914	43.935	43.957	43.978	43.999	44.020	2450	53.910	53.929	53.948								



Type T Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Fahrenheit																							
°F	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°F	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
-450	-6.254	-6.255	-6.256	-6.257	-6.258							0	-0.675	-0.654	-0.633	-0.613	-0.592	-0.571	-0.550	-0.530	-0.509	-0.488	-0.467
												10	-0.467	-0.446	-0.425	-0.404	-0.383	-0.362	-0.341	-0.320	-0.299	-0.278	-0.256
												20	-0.256	-0.235	-0.214	-0.193	-0.171	-0.150	-0.129	-0.107	-0.086	-0.064	-0.043
												30	-0.043	-0.022	0.000	0.022	0.043	0.065	0.086	0.108	0.130	0.151	0.173
												40	0.173	0.195	0.216	0.238	0.260	0.282	0.303	0.325	0.347	0.369	0.391
-440	-6.240	-6.242	-6.243	-6.245	-6.247	-6.248	-6.250	-6.251	-6.252	-6.253	-6.254	50	0.391	0.413	0.435	0.457	0.479	0.501	0.523	0.545	0.567	0.589	0.611
-430	-6.217	-6.220	-6.222	-6.225	-6.227	-6.230	-6.232	-6.234	-6.236	-6.238	-6.240	60	0.611	0.634	0.656	0.678	0.700	0.723	0.745	0.767	0.790	0.812	0.834
-420	-6.187	-6.191	-6.194	-6.197	-6.200	-6.203	-6.206	-6.209	-6.212	-6.215	-6.217	70	0.834	0.857	0.879	0.902	0.924	0.947	0.969	0.992	1.015	1.037	1.060
-410	-6.150	-6.154	-6.158	-6.162	-6.166	-6.170	-6.173	-6.177	-6.180	-6.184	-6.187	80	1.060	1.083	1.105	1.128	1.151	1.174	1.196	1.219	1.242	1.265	1.288
-400	-6.105	-6.110	-6.115	-6.119	-6.124	-6.128	-6.133	-6.137	-6.141	-6.146	-6.150	90	1.288	1.311	1.334	1.357	1.380	1.403	1.426	1.449	1.472	1.496	1.519
-390	-6.053	-6.059	-6.064	-6.069	-6.075	-6.080	-6.085	-6.090	-6.095	-6.100	-6.105	100	1.519	1.542	1.565	1.588	1.612	1.635	1.658	1.682	1.705	1.729	1.752
	-5.994	-6.001	-6.007	-6.013	-6.019	-6.025	-6.030	-6.036	-6.042	-6.047	-6.053	110	1.752	1.776	1.799	1.823	1.846	1.870	1.893	1.917	1.941	1.964	1.988
	-5.930	-5.937	-5.943	-5.950	-5.956	-5.963	-5.969	-5.976	-5.982	-5.988	-5.994	120	1.988	2.012	2.036	2.060	2.083	2.107	2.131	2.155	2.179	2.203	2.227
	-5.860	-5.867	-5.874	-5.881	-5.888	-5.896	-5.902	-5.909	-5.916	-5.923	-5.930	130	2.227	2.251	2.275	2.299	2.323	2.347	2.371	2.395	2.420	2.444	2.468
	-5.785	-5.792	-5.800	-5.808	-5.815	-5.823	-5.830	-5.838	-5.845	-5.853	-5.860	140	2.468	2.492	2.517	2.541	2.565	2.590	2.614	2.639	2.663	2.687	2.712
-340	-5.705	-5.713	-5.721	-5.729	-5.737	-5.745	-5.753	-5.761	-5.769	-5.777	-5.785	150	2.712	2.737	2.761	2.786	2.810	2.835	2.860	2.884	2.909	2.934	2.958
-330	-5.620	-5.629	-5.638	-5.646	-5.655	-5.663	-5.672	-5.680	-5.688	-5.697	-5.705	160	2.958	2.983	3.008	3.033	3.058	3.082	3.107	3.132	3.157	3.182	3.207
-320	-5.532	-5.541	-5.550	-5.559	-5.568	-5.577	-5.585	-5.594	-5.603	-5.612	-5.620	170	3.207	3.232	3.257	3.282	3.307	3.333	3.358	3.383	3.408	3.433	3.459
-310	-5.439	-5.448	-5.458	-5.467	-5.476	-5.486	-5.495	-5.504	-5.513	-5.523	-5.532	180	3.459	3.484	3.509	3.534	3.560	3.585	3.610	3.636	3.661	3.687	3.712
-300	-5.341	-5.351	-5.361	-5.371	-5.381	-5.391	-5.400	-5.410	-5.420	-5.429	-5.439	190	3.712	3.738	3.763	3.789	3.814	3.840	3.866	3.891	3.917	3.943	3.968
-290	-5.240	-5.250	-5.261	-5.271	-5.281	-5.291	-5.301	-5.312	-5.322	-5.332	-5.341	200	3.968	3.994	4.020	4.046	4.071	4.097	4.123	4.149	4.175	4.201	4.227
	-5.135	-5.145	-5.156	-5.167	-5.177	-5.188	-5.198	-5.209	-5.219	-5.230	-5.240	210	4.227	4.253	4.279	4.305	4.331	4.357	4.383	4.409	4.435	4.461	4.487
	-5.025	-5.036	-5.048	-5.059	-5.070	-5.081	-5.091	-5.102	-5.113	-5.124	-5.135	220	4.487	4.513	4.540	4.566	4.592	4.618	4.645	4.671	4.697	4.724	4.750
	-4.912	-4.923	-4.935	-4.946	-4.958	-4.969	-4.980	-4.992	-5.003	-5.014	-5.025	230	4.750	4.776	4.803	4.829	4.856	4.882	4.909	4.935	4.962	4.988	5.015
	-4.794	-4.806	-4.818	-4.830	-4.842	-4.854	-4.865	-4.877	-4.889	-4.900	-4.912	240	5.015	5.042	5.068	5.095	5.122	5.148	5.175	5.202	5.228	5.255	5.282
-240	-4.673	-4.685	-4.698	-4.710	-4.722	-4.734	-4.746	-4.759	-4.771	-4.783	-4.794	250	5.282	5.309	5.336	5.363	5.389	5.416	5.443	5.470	5.497	5.524	5.551
-230	-4.548	-4.561	-4.573	-4.586	-4.599	-4.611	-4.624	-4.636	-4.648	-4.661	-4.673	260	5.551	5.578	5.605	5.632	5.660	5.687	5.714	5.741	5.768	5.795	5.823
-220	-4.419	-4.432	-4.445	-4.458	-4.471	-4.484	-4.497	-4.510	-4.523	-4.535	-4.548	270	5.823	5.850	5.877	5.904	5.932	5.959	5.986	6.014	6.041	6.068	6.096
-210	-4.286	-4.300	-4.313	-4.326	-4.340	-4.353	-4.366	-4.380	-4.393	-4.406	-4.419	280	6.096	6.123	6.151	6.178	6.206	6.233	6.261	6.288	6.316	6.343	6.371
-200	-4.149	-4.163	-4.177	-4.191	-4.205	-4.218	-4.232	-4.246	-4.259	-4.273	-4.286	290	6.371	6.399	6.426	6.454	6.482	6.510	6.537	6.565	6.593	6.621	6.648
-190	-4.009	-4.023	-4.037	-4.052	-4.066	-4.080	-4.094	-4.108	-4.122	-4.136	-4.149	300	6.648	6.676	6.704	6.732	6.760	6.788	6.816	6.844	6.872	6.900	6.928
	-3.865	-3.879	-3.894	-3.908	-3.923	-3.937	-3.952	-3.966	-3.980	-3.995	-4.009	310	6.928	6.956	6.984	7.012	7.040	7.068	7.096	7.124	7.152	7.181	7.209
	-3.717	-3.732	-3.747	-3.762	-3.777	-3.791	-3.806	-3.821	-3.836	-3.850	-3.865	320	7.209	7.237	7.265	7.294	7.322	7.350	7.378	7.407	7.435	7.463	7.492
	-3.565	-3.581	-3.596	-3.611	-3.626	-3.642	-3.657	-3.672	-3.687	-3.702	-3.717	330	7.492	7.520	7.549	7.577	7.606	7.634	7.663	7.691	7.720	7.748	7.777
	-3.410	-3.426	-3.441	-3.457	-3.473	-3.488	-3.504	-3.519	-3.535	-3.550	-3.565	340	7.777	7.805	7.834	7.863	7.891	7.920	7.949	7.977	8.006	8.035	8.064
-140	-3.251	-3.267	-3.283	-3.299	-3.315	-3.331	-3.347	-3.363	-3.379	-3.394	-3.410	350	8.064	8.092	8.121	8.150	8.179	8.208	8.237	8.266	8.294	8.323	8.352
-130	-3.089	-3.105	-3.122	-3.138	-3.154	-3.171	-3.187	-3.203	-3.219	-3.235	-3.251	360	8.352	8.381	8.410	8.439	8.468	8.497	8.526	8.555	8.585	8.614	8.643
-120	-2.923	-2.940	-2.956	-2.973	-2.990	-3.006	-3.023	-3.040	-3.056	-3.072	-3.089	370	8.643	8.672	8.701	8.730	8.759	8.789	8.818	8.847	8.876	8.906	8.935
-110	-2.754	-2.771	-2.788	-2.805	-2.822	-2.839	-2.856	-2.873	-2.889	-2.906	-2.923	380	8.935	8.964	8.994	9.023	9.052	9.082	9.111	9.141	9.170	9.200	9.229
-100	-2.581	-2.598	-2.616	-2.633	-2.651	-2.668	-2.685	-2.702	-2.719	-2.737	-2.754	390	9.229	9.259	9.288	9.318	9.347	9.377	9.406	9.436	9.466	9.495	9.525
-90	-2.405	-2.423	-2.440	-2.458	-2.476	-2.493	-2.511	-2.529	-2.546	-2.564	-2.581	400	9.525	9.555	9.584	9.614	9.644	9.673	9.703	9.733	9.763	9.793	9.822
	-2.225	-2.244	-2.262	-2.280	-2.298	-2.316	-2.334	-2.351	-2.369	-2.387	-2.405	410	9.822	9.852	9.882	9.912	9.942	9.972	10.002	10.032	10.062	10.092	10.122
	-2.043	-2.061	-2.079	-2.098	-2.116	-2.134	-2.153	-2.171	-2.189	-2.207	-2.225	420	10.122	10.152	10.182	10.212	10.242	10.272	10.302	10.332	10.362	10.392	10.423
	-1.857	-1.875	-1.894	-1.913	-1.931	-1.950	-1.969	-1.987	-2.006	-2.024	-2.043	430	10.423	10.453	10.483	10.513	10.543	10.574	10.604	10.634	10.664	1	

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F

550	14.155	14.187	14.219	14.251	14.283	14.315	14.347	14.379	14.411	14.444	14.476	700	19.097	19.131	19.165	19.199	19.233	19.267	19.301	19.335	19.369	19.403	19.437
560	14.476	14.508	14.540	14.572	14.604	14.636	14.669	14.701	14.733	14.765	14.797	710	19.437	19.471	19.505	19.539	19.573	19.607	19.641	19.675	19.709	19.743	19.777
570	14.797	14.830	14.862	14.894	14.926	14.959	14.991	15.023	15.056	15.088	15.121	720	19.777	19.811	19.845	19.879	19.913	19.947	19.982	20.016	20.050	20.084	20.118
580	15.121	15.153	15.185	15.218	15.250	15.283	15.315	15.347	15.380	15.412	15.445	730	20.118	20.152	20.187	20.221	20.255	20.289	20.323	20.358	20.392	20.426	20.460
590	15.445	15.477	15.510	15.543	15.575	15.608	15.640	15.673	15.705	15.738	15.771	740	20.460	20.495	20.529	20.563	20.597	20.632	20.666	20.700	20.735	20.769	20.803
600	15.771	15.803	15.836	15.869	15.901	15.934	15.967	15.999	16.032	16.065	16.098	750	20.803	20.838	20.872								
610	16.098	16.130	16.163	16.196	16.229	16.262	16.295	16.327	16.360	16.393	16.426												
620	16.426	16.459	16.492	16.525	16.558	16.591	16.624	16.657	16.690	16.723	16.756												
630	16.756	16.789	16.822	16.855	16.888	16.921	16.954	16.987	17.020	17.053	17.086												
640	17.086	17.120	17.153	17.186	17.219	17.252	17.286	17.319	17.352	17.385	17.418												

Thermoelectric voltage as a function temperature (°F), reference junctions at 32°F

Type E Thermocouples

Thermoelectric Voltage in Millivolts

Celsius

Incremental degrees in Celsius																							
°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
-270	-9.835											-140	-6.907	6.945	-6.983	-7.021	-7.058	-7.096	-7.133	-7.170	-7.206	-7.243	-7.279
-260	-9.797	-9.802	-9.808	-9.813	-9.817	-9.821	-9.825	-9.828	-9.831	-9.833	-9.835	-130	-6.516	-6.556	-6.596	-6.636	-6.675	-6.714	-6.753	-6.792	-6.831	-6.869	-6.907
-250	-9.718	-9.728	-9.737	-9.746	-9.754	-9.762	-9.770	-9.777	-9.784	-9.790	-9.797	-120	-6.107	-6.149	-6.191	-6.232	-6.273	-6.314	-6.355	-6.396	-6.436	-6.476	-6.516
												-110	-5.681	-5.724	-5.767	-5.810	-5.853	-5.896	-5.939	-5.981	-6.023	-6.065	-6.107
												-100	-5.237	-5.282	-5.327	-5.372	-5.417	-5.461	-5.505	-5.549	-5.593	-5.637	-5.681
-240	-9.604	-9.617	-9.630	-9.642	-9.654	-9.666	-9.677	-9.688	-9.698	9.709	-9.718	-90	-4.777	-4.824	-4.871	-4.917	-4.963	-5.009	-5.055	-5.101	-5.147	-5.192	-5.237
-230	-9.455	-9.471	-9.487	-9.503	-9.519	-9.534	-9.548	-9.563	-9.577	-9.591	-9.604	-80	-4.302	-4.350	-4.398	-4.446	-4.494	-4.542	-4.589	-4.636	-4.684	-4.732	-4.777
-220	-9.274	-9.293	-9.313	-9.331	-9.350	-9.368	-9.386	-9.404	-9.421	-9.438	-9.455	-70	-3.811	-3.861	-3.911	-3.960	-4.009	-4.058	-4.107	-4.156	-4.205	-4.254	-4.302
-210	-9.063	-9.085	-9.107	-9.129	-9.151	-9.172	-9.193	-9.214	-9.234	-9.254	-9.274	-60	-3.306	-3.357	-3.408	-3.459	-3.510	-3.561	-3.611	-3.661	-3.711	-3.761	-3.811
-200	-8.825	-8.850	-8.874	-8.899	-8.923	-8.947	-8.971	-8.994	-9.017	-9.040	-9.063	-50	-2.787	-2.740	-2.892	-2.944	-2.996	-3.048	-3.100	-3.152	-3.204	-3.255	-3.306
												-40	-2.255	-2.309	-2.362	-2.416	-2.469	-2.523	-2.576	-2.629	-2.682	-2.735	-2.787
-190	-8.561	-8.588	-8.616	-8.643	-8.669	-8.696	-8.722	-8.748	-8.774	-8.799	-8.825	-30	-1.709	-1.765	-1.820	-1.874	-2.929	-1.984	-2.038	-2.093	-2.147	-2.201	-2.255
-180	-8.273	-8.303	-8.333	-8.362	-8.391	-8.420	-8.449	-8.477	-8.505	-8.533	-8.561	-20	-1.152	-1.208	-1.264	-1.320	-1.376	-1.432	-1.488	-1.543	-1.599	-1.654	-1.709
-170	-7.963	-7.995	-8.027	-8.059	-8.090	-8.121	-8.152	-8.183	-8.213	-8.243	-8.273	-10	-0.582	-0.639	-0.697	-0.754	-0.811	-0.868	-0.925	-0.982	-1.039	-1.095	-1.152
-160	-7.632	-7.666	-7.700	-7.733	-7.767	-7.800	-7.833	-7.866	-7.899	-7.931	-7.963	0	0.000	-0.059	-0.117	-0.176	-0.234	-0.292	-0.350	-0.408	-0.466	-0.524	-0.582
-150	-7.279	-7.315	-7.351	-7.387	-7.423	-7.458	-7.493	-7.528	-7.563	-7.597	-7.632												

Thermoelectric voltage as a function temperature (°C), reference junctions at 0°C



Type E Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Celsius

°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
0	0.000	0.059	0.118	0.176	0.235	0.294	0.354	0.413	0.472	0.532	0.591	500	37.005	37.086	37.167	37.248	37.329	37.410	37.491	37.572	37.653	37.734	37.815
10	0.591	0.651	0.711	0.770	0.830	0.890	0.950	1.010	1.071	1.131	1.192	510	37.815	37.896	37.977	38.058	38.139	38.220	38.300	38.381	38.462	38.543	38.624
20	1.192	1.252	1.313	1.373	1.434	1.495	1.556	1.617	1.678	1.740	1.801	520	38.624	38.705	38.786	38.867	38.948	39.029	39.110	39.191	39.272	39.353	39.434
30	1.801	1.862	1.924	1.986	2.047	2.109	2.171	2.233	2.295	2.357	2.420	530	39.434	39.515	39.596	39.677	39.758	39.839	39.920	40.001	40.082	40.163	40.243
40	2.240	2.482	2.545	2.607	2.670	2.733	2.795	2.858	2.921	2.984	3.048	540	40.243	40.324	40.405	40.486	40.567	40.648	40.729	40.810	40.891	40.972	41.053
50	3.048	3.111	3.174	3.238	3.301	3.365	3.429	3.492	3.556	3.620	3.685	550	41.053	41.134	41.215	41.296	41.377	41.457	41.538	41.619	41.700	41.781	41.862
60	3.685	3.749	3.813	3.877	3.942	4.006	4.070	4.136	4.200	4.265	4.330	560	41.862	41.943	42.024	42.105	42.185	42.266	42.347	42.428	42.509	42.590	42.671
70	4.330	4.395	4.460	4.526	4.591	4.656	4.722	4.788	4.853	4.919	4.985	570	42.671	42.751	42.832	42.913	42.994	43.075	43.156	43.236	43.317	43.398	43.479
80	4.985	5.051	5.117	5.183	5.249	5.315	5.382	5.448	5.514	5.581	5.648	580	43.479	43.560	43.640	43.721	43.802	43.883	43.963	44.044	44.125	44.206	44.286
90	5.648	5.714	5.781	5.848	5.915	5.982	6.049	6.117	6.184	6.251	6.319	590	44.286	44.367	44.448	44.529	44.609	44.690	44.771	44.851	44.932	45.013	45.093
100	6.319	6.386	6.454	6.522	6.590	6.658	6.725	6.794	6.862	6.930	6.998	600	45.093	45.174	45.255	45.335	45.416	45.497	45.577	45.658	45.738	45.819	45.900
110	6.998	7.066	7.135	7.203	7.272	7.341	7.409	7.478	7.547	7.616	7.685	610	45.900	45.980	46.061	46.141	46.222	46.302	46.383	46.463	46.544	46.624	46.705
120	7.685	7.754	7.823	7.892	7.962	8.031	8.101	8.170	8.240	8.309	8.379	620	46.705	46.785	46.866	46.946	47.027	47.107	47.188	47.268	47.349	47.429	47.509
130	8.379	8.449	8.519	8.589	8.659	8.729	8.799	8.869	8.940	9.010	9.081	630	47.509	47.590	47.670	47.751	47.831	47.911	47.992	48.072	48.152	48.233	48.313
140	9.081	9.151	9.222	9.292	9.363	9.434	9.505	9.576	9.647	9.718	9.789	640	48.313	48.393	48.474	48.554	48.634	48.715	48.795	48.875	48.955	49.035	49.116
150	9.860	9.931	10.003	10.074	10.145	10.217	10.288	10.360	10.432	10.503		650	49.116	49.196	49.276	49.356	49.436	49.517	49.597	49.677	49.757	49.837	49.917
160	10.503	10.575	10.647	10.719	10.791	10.863	10.935	11.007	11.080	11.152	11.224	660	49.917	49.997	50.077	50.157	50.238	50.318	50.398	50.478	50.558	50.638	50.718
170	11.224	11.297	11.369	11.442	11.514	11.587	11.660	11.733	11.805	11.878	11.951	670	50.718	50.798	50.878	50.958	51.038	51.118	51.197	51.277	51.357	51.437	51.517
180	11.951	12.024	12.097	12.170	12.243	12.317	12.390	12.463	12.537	12.610	12.684	680	51.517	51.597	51.677	51.757	51.837	51.916	51.996	52.076	52.156	52.236	52.315
190	12.684	12.757	12.831	12.904	12.978	13.052	13.126	13.199	13.273	13.347	13.421	690	52.315	52.395	52.475	52.555	52.634	52.714	52.794	52.873	52.953	53.033	53.112
200	13.421	13.495	13.569	13.643	13.717	13.792	13.866	13.941	14.015	14.090	14.164	700	53.112	53.192	53.272	53.351	53.431	53.510	53.590	53.670	53.749	53.829	53.908
210	14.164	14.239	14.313	14.388	14.463	14.537	14.612	14.687	14.762	14.837	14.912	710	53.908	53.988	54.067	54.147	54.226	54.306	54.385	54.465	54.544	54.624	54.703
220	14.912	14.987	15.062	15.137	15.212	15.287	15.362	15.437	15.512	15.587	15.662	720	54.703	54.782	54.862	54.941	55.021	55.100	55.179	55.259	55.338	55.417	55.497
230	15.664	15.739	15.815	15.890	15.966	16.041	16.117	16.193	16.269	16.344	16.420	730	55.497	55.576	55.655	55.734	55.814	55.893	55.972	56.051	56.131	56.210	56.289
240	16.420	16.572	16.672	16.748	16.824	16.900	16.976	17.052	17.128	17.204	17.281	740	56.289	56.368	56.447	56.526	56.605	56.684	56.763	56.842	56.921	57.000	57.079
250	17.181	17.333	17.433	17.509	17.585	17.661	17.737	17.813	17.889	17.965	18.041	750	57.080	57.159	57.238	57.317	57.396	57.475	57.554	57.633	57.712	57.791	57.870
260	17.945	18.098	18.198	18.274	18.350	18.426	18.502	18.578	18.654	18.730	18.806	760	57.870	57.949	58.028	58.107	58.186	58.265	58.344	58.423	58.502	58.581	58.660
270	18.713	18.866	18.966	19.042	19.118	19.194	19.270	19.346	19.422	19.498	19.574	770	58.659	58.738	58.817	58.896	58.975	59.054	59.133	59.212	59.291	59.370	59.449
280	19.484	19.637	19.737	19.813	19.889	19.965	20.041	20.117	20.193	20.269	20.345	780	59.446	59.525	59.604	59.683	59.762	59.841	59.920	60.000	60.079	60.158	60.237
290	20.259	20.412	20.512	20.588	20.664	20.740	20.816	20.892	20.968	21.044	21.120	790	60.232	60.311	60.390	60.469	60.548	60.627	60.706	60.785	60.864	60.943	61.022
300	21.036	21.189	21.289	21.365	21.441	21.517	21.593	21.669	21.745	21.821	21.897	800	61.017	61.096	61.175	61.254	61.333	61.412	61.491	61.570	61.649	61.728	61.807
310	21.817	21.970	22.070	22.146	22.222	22.298	22.374	22.450	22.526	22.602	22.678	810	61.801	61.880	61.959	62.038	62.117	62.196	62.275	62.354	62.433	62.512	62.591
320	22.600	22.753	22.853	22.929	23.005	23.081	23.157	23.233	23.309	23.385	23.461	820	62.583	62.662	62.741	62.820	62.899	62.978	63.057	63.136	63.215	63.294	63.373
330	23.386	23.539	23.639	23.715	23.791	23.867	23.943	24.019	24.095	24.171	24.247	830	63.364	63.443	63.522	63.601	63.680	63.759	63.838	63.917	63.996	64.075	64.154
340	24.174	24.327	24.427	24.503	24.579	24.655	24.731	24.807	24.883	24.959	25.035	840	64.144	64.223	64.302	64.381	64.460	64.539	64.618	64.697	64.776	64.855	64.934
350	24.964	25.117	25.217	25.293	25.369	25.445	25.521	25.597	25.673	25.749	25.825	850	64.922	65.001	65.080	65.159	65.238	65.317	65.396	65.475	65.554	65.633	65.712
360	25.757	25.910	26.010	26.086	26.162	26.238	26.314	26.390	26.466	26.542	26.618	860	65.698	65.777	65.856	65.935	66.014	66.093	66.172	66.251	66.330	66.409	66.488
370	26.552	26.705	26.805	26.881	26.957	27.033	27.109	27.185	27.261	27.337	27.413	870	66.473	66.552	66.631	66.710	66.789	66.868	66.947	67.026	67.105	67.184	67.263
380	27.348	27.501	27.601	27.677	27.753	27.829	27.905	27.981	28.057	28.133	28.209	880	67.246	67.325	67.404	67.483	67.562	67.641	67.720	67.799	67.878	67.957	68.036
390	28.146	28.299	28.399	28.475	28.551	28.627	28.703	28.779	28.855	28.931	29.007	890	68.017	68.096	68.175	68.254	68.333	68.412	68.491	68.570	68.649	68.728	68.807
400	28.946	29.099	29.199	29.275	29.351	29.427	29.503	29.579	29.655	29.731	29.807	900	68.787	68.866	68.945	69.024	69.103	69.182	69.261	69.340	69.419	69.498	69.577
410	29.747	29.900	29.999	30.075	30.151	30.227	30.303	30.379	30.455	30.531	30.607	910	69.554	69.633	69.712	69.791	69.870	69.949	70.028	70.107	70.186	70.265	70.344
420	30.550	30.703	30.803	30.879	30.955	31.031	31.107	31.183	31.259	31.335	31.411	920	70.319	70.398	70.477	70.556	70.635	70.714	70.793	70.872	70.951	71.030	71.109
430	31.354	31.507	31.607	31.683	31.759	31.835	31.911	31.987	32.063	32.139	32.215	930	71.082	71.161	71.240	71.319	71.398	71.477	71.556	71.635	71.714	71.793	71.872
440	32.159	32.312	32.412	32.488	32.564	32.640	32.716	32.792	32.868	32.944	33.020	940	71.844	71.923	72.002	72.081	72.160	72.239	72.318	72.397	72.476	72.555	72.634
450	32.965	33.118	33.218	33.294	33.370	33.446	33.522	33.598	33.674	33.750	33.826	950	72.603	72.682	72.761	72.840	72.919	73.000	73.079	73.158	73.237	73.316	73.395
460	33.772	33.925	34.025	34.101	34.177	34.253	34.329	34.405	34.481	34.557	34.633	960	73.360	73.439	73.518	73.597	7						



Type J Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Celsius																							
°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
-210	-8.095											0	0.000	0.050	0.101	0.151	0.202	0.253	0.303	0.354	0.405	0.456	0.507
												10	0.507	0.558	0.609	0.660	0.711	0.762	0.814	0.865	0.916	0.968	1.019
												20	1.019	1.071	1.122	1.174	1.226	1.277	1.329	1.381	1.433	1.485	1.537
												30	1.537	1.589	1.641	1.693	1.745	1.797	1.849	1.902	1.954	2.006	2.059
												40	2.059	2.111	2.164	2.216	2.269	2.322	2.374	2.427	2.480	2.532	2.585
-200	-7.890	-7.912	-7.934	-7.955	-7.976	-7.996	-8.017	-8.037	-8.057	-8.076	-8.095												
-190	-7.659	-7.663	-7.707	-7.731	-7.755	-7.778	-7.801	-7.824	-7.846	-7.868	-7.890	50	2.585	2.638	2.691	2.744	2.797	2.850	2.903	2.956	3.009	3.062	3.116
	-7.403	-7.429	-7.456	-7.482	-7.508	-7.534	-7.559	-7.585	-7.610	-7.634	-7.659	60	3.116	3.169	3.222	3.275	3.329	3.382	3.436	3.489	3.543	3.596	3.650
	-7.123	-7.152	-7.181	-7.209	-7.237	-7.265	-7.293	-7.321	-7.348	-7.376	-7.403	70	3.650	3.703	3.757	3.810	3.864	3.918	3.971	4.025	4.079	4.133	4.187
	-6.821	-6.853	-6.883	-6.914	-6.944	-6.975	-7.005	-7.035	-7.064	-7.094	-7.123	80	4.187	4.240	4.294	4.348	4.402	4.456	4.510	4.564	4.618	4.672	4.726
	-6.500	-6.533	-6.566	-6.598	-6.631	-6.663	-6.695	-6.727	-6.759	-6.690	-6.821	90	4.726	4.781	4.835	4.889	4.943	4.997	5.052	5.106	5.160	5.215	5.269
-140	-6.159	-6.194	-6.229	-6.263	-6.298	-6.332	-6.366	-6.400	-6.433	-6.467	-6.500	100	5.269	5.323	5.378	5.432	5.487	5.541	5.595	5.650	5.705	5.759	5.814
	-5.801	-5.838	-5.874	-5.910	-5.946	-5.982	-6.018	-6.054	-6.089	-6.124	-6.159	110	5.814	5.868	5.923	5.977	6.032	6.087	6.141	6.196	6.251	6.306	6.360
	-5.426	-5.465	-5.503	-5.541	-5.578	-5.616	-5.653	-5.690	-5.727	-5.764	-5.801	120	6.360	6.415	6.470	6.525	6.579	6.634	6.689	6.744	6.799	6.854	6.909
	-5.037	-5.076	-5.116	-5.155	-5.194	-5.233	-5.272	-5.311	-5.350	-5.388	-5.426	130	6.909	6.964	7.019	7.074	7.129	7.184	7.239	7.294	7.349	7.404	7.459
	-4.633	-4.674	-4.714	-4.755	-4.796	-4.836	-4.877	-4.917	-4.967	-4.997	-5.037	140	7.459	7.514	7.569	7.624	7.679	7.734	7.789	7.844	7.900	7.955	8.010
-90	-4.215	-4.257	-4.300	-4.342	-4.384	-4.425	-4.467	-4.509	-4.550	-4.591	-4.633	150	8.010	8.065	8.120	8.175	8.231	8.286	8.341	8.396	8.452	8.507	8.562
	-3.786	-3.829	-3.872	-3.916	-3.959	-4.002	-4.045	-4.088	-4.130	-4.173	-4.215	160	8.562	8.618	8.673	8.728	8.783	8.839	8.894	8.949	9.005	9.060	9.115
	-3.344	-3.389	-3.434	-3.478	-3.522	-3.566	-3.610	-3.654	-3.698	-3.742	-3.786	170	9.115	9.171	9.226	9.282	9.337	9.392	9.448	9.503	9.559	9.614	9.669
	-2.893	-2.938	-2.984	-3.029	-3.075	-3.120	-3.165	-3.210	-3.255	-3.300	-3.344	180	9.669	9.7525	9.780	9.836	9.891	9.947	10.002	10.057	10.113	10.168	10.224
	-2.431	-2.478	-2.524	-2.571	-2.617	-2.663	-2.709	-2.755	-2.801	-2.847	-2.893	190	10.224	10.279	10.335	10.390	10.446	10.501	10.557	10.612	10.668	10.723	10.779
-40	-1.961	-2.008	-2.055	-2.103	-2.150	-2.197	-2.244	-2.291	-2.338	-2.385	-2.431	200	10.779	10.834	10.890	10.945	11.001	11.057	11.112	11.167	11.223	11.278	11.334
	-1.482	-1.530	-1.578	-1.626	-1.674	-1.722	-1.770	-1.818	-1.865	-1.913	-1.961	210	11.334	11.389	11.445	11.501	11.556	11.612	11.667	11.723	11.778	11.834	11.889
	-0.995	-1.044	-1.093	-1.142	-1.190	-1.239	-1.288	-1.336	-1.385	-1.433	-1.482	220	11.889	11.945	12.000	12.056	12.111	12.167	12.222	12.278	12.334	12.389	12.445
	-0.501	-0.550	-0.600	-0.650	-0.699	-0.749	-0.798	-0.847	-0.896	-0.946	-0.995	230	12.445	12.500	12.556	12.611	12.667	12.722	12.778	12.833	12.889	12.944	13.000
	0	0.000	-0.050	-0.101	-0.151	-0.201	-0.251	-0.301	-0.351	-0.401	-0.451	-0.501	240	13.000	13.056	13.111	13.167	13.222	13.278	13.333	13.389	13.444	13.500
												250	13.555	13.611	13.666	13.722	13.777	13.833	13.888	13.955	13.999	14.055	14.110
												260	14.110	14.166	14.221	14.277	14.332	14.388	14.443	14.499	14.554	14.609	14.665
												270	14.665	14.720	14.776	14.831	14.887	14.942	14.998	15.053	15.109	15.164	15.219
												280	15.219	15.275	15.330	15.386	15.441	15.496	15.552	15.607	15.663	15.718	15.773
												290	15.773	15.829	15.884	15.940	15.995	16.050	16.106	16.161	16.216	16.272	16.327
												300	16.327	16.383	16.438	16.493	16.549	16.604	16.659	16.715	16.770	16.825	16.881
												310	16.881	16.936	16.991	17.046	17.102	17.157	17.212	17.268	17.323	17.378	17.434
												320	17.434	17.489	17.544	17.599	17.655	17.710	17.765	17.820	17.876	17.931	17.986
												330	17.986	18.041	18.097	18.152	18.207	18.262	18.318	18.373	18.428	18.483	18.538
												340	18.538	18.594	18.649	18.704	18.759	18.814	18.870	18.925	18.980	19.035	19.090
												350	19.090	19.146	19.201	19.256	19.311	19.366	19.422	19.477	19.532	19.587	19.642
												360	19.642	19.697	19.753	19.808	19.863	19.918	19.973	20.028	20.083	20.139	20.194
												370	20.194	20.249	20.304	20.359	20.414	20.469	20.525	20.580	20.635	20.690	20.745
												380	20.745	20.800	20.855	20.911	20.966	21.021	21.076	21.131	21.186	21.241	21.297
												390	21.297	21.352	21.407	21.462	21.517	21.572	21.627	21.683	21.738	21.793	21.848
												400	21.848	21.903	21.958	22.014	22.069	22.124	22.179	22.234	22.289	22.345	22.400
												410	22.400	24.455	22.510	22.565	22.620	22.676	22.731	22.786	22.841	22.896	22.952
												420	22.952	23.007	23.062	23.117	23.172	23.228	23.283	23.338	23.393	23.449	23.504
												430	23.504	23.559	23.614	23.670	23.725	23.780	23.835	23.891	23.946	24.001	24.057
												440	24.057	24.112	24.167	24.223	24.278	24.333	24.389	24.444	24.499	24.555	24.610
												450	24.610	24.665	24.721	24.776	24.832	24.887	24.943	24.998	25.053	25.109	25.164
												460	25.174	25.220	25.275	25.331	25.386	25.442	25.497	25.583	25.608	25.664	25.720
												470	25.720	25.775	25.831	25.886	25.942	25.998	26.053	26.109	26.165	26.220	26.276
												480	26.276	26.332	26.387	26.443	26.499	26.555	26.610	26.666	26.722	26.778	26.834
												490	26.834	26.889	26.945	27.001	27.057	27.113	27.169	27.225	27.281	27.337	27.393

Thermoelectric voltage as a function temperature (°C), reference junctions at 0°C



Type J Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Celsius																							
°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
500	27.393	27.449	27.505	27.561	27.617	27.673	27.729	27.785	27.841	27.897	27.953	1000	57.953	58.013	58.072	58.131	58.190	58.249	58.309	58.368	58.427	58.486	58.545
510	27.953	28.010	28.066	28.122	28.178	28.234	28.291	28.347	28.403	28.460	28.516	1010	58.545	58.604	58.663	58.722	58.781	58.840	58.899	58.957	59.016	59.075	59.134
520	28.516	28.572	28.629	28.685	28.741	28.798	28.854	28.911	28.967	29.024	29.080	1020	59.134	59.193	59.252	59.310	59.369	59.428	59.487	59.545	59.604	59.663	59.721
530	29.080	29.137	29.194	29.250	29.307	29.363	29.420	29.477	29.534	29.590	29.647	1030	59.721	59.780	59.838	59.897	59.956	60.014	60.073	60.131	60.194	60.248	60.307
540	29.647	29.704	29.761	29.818	29.874	29.931	29.988	30.045	30.102	30.159	30.216	1040	60.307	60.365	60.423	60.482	60.540	60.599	60.657	60.715	60.774	60.832	60.890
550	30.216	30.273	30.330	30.387	30.444	30.502	30.559	30.616	30.673	30.730	30.788	1050	60.890	60.949	61.007	61.065	61.123	61.182	61.240	61.298	61.356	61.415	61.473
560	30.788	30.845	30.902	30.960	31.017	31.074	31.132	31.189	31.247	31.304	31.362	1060	61.473	61.531	61.589	61.647	61.705	61.763	61.822	61.880	61.938	61.996	62.054
570	31.362	30.419	31.477	31.535	31.592	31.650	31.708	31.766	31.823	31.881	31.939	1070	62.054	62.112	62.170	62.228	62.286	62.344	62.402	62.460	62.518	62.576	62.634
580	31.939	31.997	32.055	32.113	32.171	32.229	32.287	32.345	32.403	32.461	32.519	1080	62.634	62.692	62.750	62.808	62.866	62.924	62.982	63.040	63.098	63.156	63.214
590	32.519	32.577	32.636	32.694	32.752	32.810	32.868	32.927	32.985	33.044	33.102	1090	63.214	63.271	63.329	63.387	63.445	63.503	63.561	63.619	63.677	63.734	63.792
600	33.102	33.161	33.219	33.278	33.336	33.395	33.454	33.513	33.571	33.630	33.689	1100	63.792	63.850	63.908	63.966	64.024	64.081	64.139	64.197	64.255	64.313	64.370
610	33.689	33.748	33.807	33.866	33.924	33.983	34.042	34.101	34.159	34.218	34.277	1110	64.370	64.428	64.486	64.544	64.602	64.659	64.717	64.775	64.833	64.890	64.948
620	34.279	34.338	34.397	34.455	34.514	34.573	34.632	34.691	34.749	34.808	34.867	1120	64.948	65.006	65.064	65.122	65.179	65.237	65.295	65.353	65.411	65.468	65.525
630	34.873	34.932	34.991	35.050	35.108	35.167	35.226	35.284	35.343	35.401	35.460	1130	65.525	65.583	65.641	65.699	65.756	65.814	65.872	65.929	65.987	66.045	66.102
640	35.470	35.530	35.590	35.650	35.710	35.770	35.830	35.890	35.950	36.010	36.071	1140	66.102	66.160	66.218	66.275	66.333	66.391	66.448	66.506	66.564	66.621	66.679
650	36.071	36.131	36.191	36.252	36.313	36.373	36.433	36.494	36.554	36.615	36.675	1150	66.679	66.737	66.794	66.852	66.910	66.967	67.025	67.082	67.140	67.198	67.255
660	36.675	36.736	36.797	36.858	36.919	36.979	37.040	37.101	37.162	37.223	37.284	1160	67.255	67.313	67.370	67.428	67.486	67.543	67.601	67.658	67.716	67.773	67.831
670	37.284	37.345	37.406	37.467	37.528	37.589	37.650	37.711	37.772	37.833	37.894	1170	67.831	67.888	67.946	68.003	68.061	68.119	68.176	68.234	68.291	68.348	68.406
680	37.896	37.958	38.019	38.081	38.142	38.204	38.265	38.327	38.389	38.450	38.512	1180	68.406	68.463	68.521	68.578	68.636	68.693	68.751	68.808	68.865	68.923	68.980
690	38.512	38.574	38.636	38.698	38.760	38.822	38.884	38.946	39.008	39.070	39.132	1190	68.980	69.037	69.095	69.152	69.209	69.267	69.324	69.381	69.439	69.496	69.553
700	39.132	39.194	39.256	39.318	39.380	39.443	39.505	39.568	39.630	39.693	39.755	1200	69.553										
710	39.755	39.818	39.880	39.943	40.006	40.068	40.131	40.193	40.256	40.319	40.382												
720	40.382	40.445	40.508	40.570	40.633	40.696	40.759	40.822	40.885	40.948	41.012												
730	41.012	41.075	41.138	41.201	41.264	41.327	41.390	41.453	41.516	41.579	41.642												
740	41.645	41.708	41.772	41.835	41.898	41.962	42.025	42.089	42.152	42.216	42.280												
750	42.281	42.344	42.408	42.472	42.535	42.599	42.663	42.727	42.791	42.855	42.919												
760	42.919	42.983	43.047	43.111	43.175	43.239	43.303	43.367	43.431	43.495	43.559												
770	43.559	43.623	43.687	43.751	43.815	43.879	43.943	44.007	44.071	44.135	44.199												
780	44.203	44.267	44.331	44.395	44.459	44.523	44.587	44.651	44.715	44.779	44.843												
790	44.848	44.912	44.976	45.040	45.104	45.168	45.232	45.296	45.360	45.424	45.488												
800	45.494	45.558	45.622	45.686	45.750	45.814	45.878	45.942	46.006	46.070	46.134												
810	46.141	46.205	46.269	46.333	46.397	46.461	46.525	46.589	46.653	46.717	46.781												
820	46.786	46.850	46.914	46.978	47.042	47.106	47.170	47.234	47.298	47.362	47.426												
830	47.431	47.495	47.559	47.623	47.687	47.751	47.815	47.879	47.943	48.007	48.071												
840	48.074	48.138	48.202	48.266	48.330	48.394	48.458	48.522	48.586	48.650	48.714												
850	48.715	48.779	48.843	48.907	48.971	49.035	49.099	49.163	49.227	49.291	49.355												
860	49.353	49.417	49.481	49.545	49.609	49.673	49.737	49.801	49.865	49.929	49.993												
870	49.989	50.053	50.117	50.181	50.245	50.309	50.373	50.437	50.501	50.565	50.629												
880	50.622	50.686	50.750	50.814	50.878	50.942	51.006	51.070	51.134	51.198	51.262												
890	51.251	51.315	51.379	51.443	51.507	51.571	51.635	51.699	51.763	51.827	51.891												
900	51.877	51.941	52.005	52.069	52.133	52.197	52.261	52.325	52.389	52.453	52.517												
910	52.500	52.564	52.628	52.692	52.756	52.820	52.884	52.948	53.012	53.076	53.140												
920	53.119	53.183	53.247	53.311	53.375	53.439	53.503	53.567	53.631	53.695	53.759												
930	53.735	53.799	53.863	53.927	53.991	54.055	54.119	54.183	54.247	54.311	54.375												
940	54.347	54.411	54.475	54.539	54.603	54.667	54.731	54.795	54.859	54.923	54.987												
950	54.956	55.020	55.084	55.148	55.212	55.276	55.340	55.404	55.468	55.532	55.596												
960	55.561	55.625	55.689	55.753	55.817	55.881	55.945	56.009	56.073	56.137	56.201												
970	56.164	56.228	56.292	56.356	56.420	56.484	56.548	56.612	56.676	56.740	56.804												
980	56.763	56.827	56.891	56.955	57.019	57.083	57.147	57.211	57.275	57.339	57.403												
990	57.360	57.424	57.488	57.552	57.616	57.680	57.744	57.808	57.872	57.936	57.999												

Thermoelectric voltage as a function temperature (°C), reference junctions at 0°C

-260	-6.441	-6.444	-6.446	-6.448	-6.450	-6.452	-6.453	-6.455	-6.456	-6.457	-6.458	30	1.801	1.862	1.924	1.986	2.047	2.109	2.171	2.233	2.295	2.357	2.420
-250	-6.404	-6.408	-6.413	-6.417	-6.421	-6.425	-6.429	-6.432	-6.435	-6.438	-6.441	40	2.240	2.482	2.545	2.607	2.670	2.733	2.795	2.858	2.921	2.984	3.048
-240	-6.344	-6.351	-6.358	-6.364	-6.370	-6.377	-6.382	-6.388	-6.393	-6.399	-6.404	50	3.048	3.111	3.174	3.238	3.301	3.365	3.429	3.492	3.556	3.620	3.685
-230	-6.262	-6.271	-6.280	-6.289	-6.297	-6.306	-6.314	-6.322	-6.329	-6.337	-6.344	60	3.685	3.749	3.813	3.877	3.942	4.006	4.071	4.136	4.200	4.265	4.330
-220	-6.158	-6.170	-6.181	-6.192	-6.202	-6.213	-6.223	-6.233	-6.243	-6.252	-6.262	70	4/330	4.395	4.460	4.526	4.591	4.656	4.722	4.788	4.753	4.919	4.985
-210	-6.035	-6.048	-6.061	-6.074	-6.087	-6.099	-6.111	-6.123	-6.135	-6.147	-6.158	80	4.985	5.051	5.117	5.183	5.249	5.315	5.382	5.448	5.514	5.581	5.648
-200	-5.891	-5.907	-5.922	-5.936	-5.951	-5.965	-5.980	-5.994	-6.007	-6.021	-6.035	90	5.648	5.714	5.781	5.848	5.915	5.982	6.049	6.117	6.184	6.251	6.319
-190	-5.730	-5.747	-5.763	-5.780	-5.797	-5.813	-5.829	-5.845	-5.861	-5.876	-5.891	100	6.319	6.386	6.454	6.522	6.590	6.658	6.725	6.794	6.862	6.930	6.998
-180	-5.550	-5.569	-5.588	-5.606	-5.624	-5.642	-5.660	-5.678	-5.695	-5.713	-5.730	110	6.998	7.066	7.135	7.203	7.272	7.341	7.409	7.478	7.547	7.616	7.685
-170	-5.354	-5.374	-5.395	-5.415	-5.435	-5.454	-5.474	-5.493	-5.512	-5.531	-5.550	120	7.685	7.854	7.823	7.892	7.962	8.031	8.101	8.170	8.240	8.309	8.379
-160	-5.141	-5.163	-5.185	-5.207	-5.228	-5.250	-5.271	-5.292	-5.313	-5.333	-5.354	130	8.379	8.449	8.519	8.589	8.659	8.729	8.799	8.869	8.940	9.010	9.081
-150	-4.913	-4.936	-4.960	-4.983	-5.006	-5.029	-5.052	-5.074	-5.097	-5.119	-5.141	140	9.801	9.151	9.222	9.292	9.363	9.434	9.505	9.576	9.647	9.718	9.789
-140	-4.669	-4.694	-4.719	-4.744	-4.768	-4.793	-4.817	-4.841	-4.865	-4.889	-4.913	150	9.860	9.860	9.931	10.003	10.047	10.145	10.217	10.288	10.360	10.432	10.503
-130	-4.411	-4.437	-4.463	-4.490	-4.516	-4.542	-4.567	-4.593	-4.618	-4.644	-4.669	160	20.575	10.575	10.647	10.719	10.791	10.863	10.935	11.007	11.080	11.152	11.224
-120	-4.138	-4.166	-4.194	-4.221	-4.249	-4.276	-4.303	-4.330	-4.357	-4.384	-4.411	170	11.224	11.297	11.369	11.442	11.514	11.587	11.660	11.733	11.805	11.878	11.951
-110	-3.852	-3.882	-3.911	-3.939	-3.968	-3.997	-4.025	-4.054	-4.082	-4.110	-4.138	180	11.951	12.024	12.097	12.170	12.243	12.317	12.390	12.463	12.537	12.610	12.684
-100	-3.554	-3.584	-3.614	-3.645	-3.675	-3.705	-3.734	-3.764	-3.794	-3.823	-3.852	190	12.684	12.757	12.831	12.904	12.978	13.052	13.126	13.199	13.273	13.347	13.421
-90	-3.243	-3.274	-3.306	-3.337	-3.368	-3.400	-3.431	-3.462	-3.492	-3.523	-3.554	200	13.421	13.495	13.569	13.664	13.718	13.792	13.866	13.941	14.015	14.090	14.164
-80	-2.920	-2.953	-2.986	-3.018	-3.050	-3.083	-3.115	-3.147	-3.179	-3.211	-3.243	210	13.164	14.239	14.313	14.388	14.463	14.537	14.612	14.687	14.762	14.837	14.912
-70	-2.587	-2.620	-2.654	-2.688	-2.721	-2.755	-2.788	-2.821	-2.854	-2.887	-2.920	220	14.912	14.098	15.062	15.137	15.212	15.287	15.362	15.438	15.513	15.588	15.664
-60	-2.243	-2.278	-2.312	-2.347	-2.382	-2.416	-2.450	-2.485	-2.519	-2.553	-2.587	230	15.664	15.739	15.815	15.890	15.966	16.041	16.117	16.193	16.269	16.344	16.420
-50	-1.889	-1.925	-1.961	-1.996	-2.032	-2.067	-2.103	-2.138	-2.173	-2.208	-2.243	240	16.420	16.572	16.572	16.648	16.724	16.800	16.876	16.952	17.028	17.104	17.181
-40	-1.527	-1.564	-1.600	-1.637	-1.673	-1.709	-1.745	-1.782	-1.818	-1.854	-1.889	250	17.815	17.333	17.333	17.409	17.486	17.562	17.639	17.715	17.792	17.868	17.945
-30	-1.156	-1.194	-1.231	-1.268	-1.305	-1.343	-1.380	-1.417	-1.453	-1.490	-1.527	260	17.945	18.098	18.098	18.175	18.252	18.328	18.405	18.482	18.559	18.636	18.713
-20	-0.778	-0.816	-0.854	-0.892	-0.930	-0.968	-1.006	-1.043	-1.081	-1.119	-1.156	270	18.713	18.790	18.867	18.944	19.021	19.098	19.175	19.252	19.330	19.407	19.484
-10	-0.392	-0.431	-0.470	-0.508	-0.547	-0.586	-0.624	-0.663	-0.701	-0.739	-0.778	280	19.484	19.561	19.639	19.716	19.794	19.871	19.948	20.026	20.103	20.181	20.259
0	0.000	-0.039	-0.079	-0.118	-0.157	-0.197	-0.236	-0.275	-0.314	-0.353	-0.392	290	20.259	20.336	20.414	20.492	20.569	20.647	20.725	20.803	20.880	20.958	21.036
												300	21.036	21.114	21.192	21.270	21.348	21.426	21.504	21.582	21.660	21.739	21.817
												310	21.817	21.895	21.973	22.051	22.130	22.208	22.286	22.365	22.443	22.522	22.600
												320	22.600	22.678	22.757	22.835	22.914	22.993	23.071	23.150	23.228	23.307	23.386
												330	23.386	23.464	23.543	23.622	23.701	23.780	23.858	23.937	24.016	24.095	24.174
												340	24.174	24.253	24.332	24.411	24.490	24.569	24.648	24.727	24.806	24.885	24.964
												350	24.964	25.044	25.123	25.202	25.281	25.360	25.440	25.519	25.598	25.678	25.757
												360	25.757	25.836	25.916	26.005	26.075	26.154	26.233	26.313	26.392	26.472	26.552
												370	26.552	26.631	26.711	26.790	26.870	26.950	27.029	27.109	27.189	27.268	27.348
												380	27.348	27.507	27.507	27.587	27.667	27.747	27.827	27.907	27.986	28.066	28.146
												390	28.146	28.226	28.306	28.386	28.466	28.546	28.626	28.706	28.786	28.866	28.946
												400	28.946	29.026	29.106	29.185	29.266	29.346	29.427	29.507	29.587	29.667	29.747
												410	29.747	29.827	29.908	29.988	30.068	31.148	30.229	30.309	30.389	30.470	30.550
												420	30.550	30.630	30.711	30.791	30.871	30.952	31.032	31.112	31.193	31.273	31.354
												430	31.354	31.434	31.515	31.595	31.676	31.756	31.837	31.917	31.998	32.078	32.159
												440	32.159	32.239	32.320	32.400	32.481	32.562	32.642	32.723	32.803	32.884	32.965
												450	32.965	33.045	33.126	33.207	33.287	33.368	33.449	33.529	33.610	33.691	33.772
												460	33.772	33.852	33.933	34.014	34.095	34.175	34.256	34.337	34.418	34.498	34.579
												470	34.579	34.660	34.741	34.822	34.902	34.983	35.064	35.145	35.226	35.307	35.387
												480	35.387	35.468	35.549	35.630	35.711	35.792	35.873	35.954	36.034	36.115	36.196
												490	36.196	36.277	36.358	36.439	36.520	36.601	36.682	36.763	36.843	36.924	37.005

Thermoelectric voltage as a function temperature (°C), reference junctions at 0°C



Type K Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Celsius

°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
500	20.664	20.687	20.730	20.772	20.815	20.857	20.900	20.943	20.985	21.028	21.071	1000	41.276	41.315	41.354	41.393	41.431	41.470	41.509	41.548	41.587	41.626	41.665
510	21.071	21.113	21.156	21.199	21.241	21.284	21.326	21.369	21.412	21.454	21.497	1010	41.665	41.704	41.743	41.781	41.820	41.859	41.898	41.937	41.976	42.014	42.053
520	21.497	21.540	21.582	21.625	21.668	21.710	21.753	21.796	21.838	21.881	21.924	1020	42.053	42.092	42.131	42.169	42.208	42.247	42.286	42.324	42.363	42.402	42.440
530	21.924	21.966	22.009	22.052	22.094	22.137	22.179	22.222	22.265	22.307	22.350	1030	42.440	42.479	42.518	42.556	42.595	42.633	42.672	42.711	42.749	42.788	42.826
540	22.350	22.393	22.435	22.478	22.521	22.563	22.606	22.649	22.691	22.734	22.776	1040	42.826	42.865	42.903	42.942	42.980	43.019	43.057	43.096	43.134	43.173	43.211
550	22.776	22.819	22.862	22.904	22.947	22.990	23.032	23.075	23.117	23.160	23.203	1050	43.211	43.250	43.288	43.327	43.365	43.403	43.442	43.480	43.518	43.557	43.595
560	23.203	23.245	23.288	23.331	23.373	23.416	23.458	23.501	23.544	23.586	23.629	1060	43.595	43.633	43.672	43.710	43.748	43.787	43.825	43.863	43.901	43.940	43.978
570	23.629	23.671	23.714	23.757	23.799	23.842	23.884	23.927	23.970	24.012	24.055	1070	43.978	44.016	44.054	44.092	44.130	44.169	44.207	44.245	44.283	44.321	44.359
580	24.055	24.097	24.140	24.182	24.225	24.267	24.310	24.353	24.395	24.438	24.480	1080	44.359	44.397	44.435	44.473	44.512	44.550	44.588	44.626	44.664	44.702	44.740
590	24.480	24.523	24.565	24.608	24.650	24.693	24.735	24.778	24.820	24.863	24.905	1090	44.740	44.778	44.816	44.853	44.891	44.929	44.967	45.005	45.043	45.081	45.119
600	24.905	24.948	24.990	25.033	25.075	25.118	25.160	25.203	25.245	25.288	25.330	1100	45.119	45.157	45.194	45.232	45.270	45.308	45.346	45.383	45.421	45.459	45.497
610	25.330	25.373	25.415	25.458	25.500	25.543	25.585	25.627	25.670	25.712	25.755	1110	45.497	45.534	45.572	45.610	45.647	45.685	45.723	45.760	45.798	45.836	45.873
620	25.755	25.797	25.840	25.882	25.924	25.967	26.009	26.052	26.094	26.136	26.179	1120	45.873	45.911	45.948	45.986	46.024	46.061	46.099	46.136	46.174	46.211	46.249
630	26.179	26.221	26.263	26.306	26.348	26.390	26.433	26.475	26.517	26.560	26.602	1130	46.249	46.286	46.324	46.361	46.398	46.436	46.473	46.511	46.548	46.585	46.623
640	26.602	26.644	26.687	26.729	26.771	26.814	26.856	26.898	26.940	26.983	27.025	1140	46.623	46.660	46.697	46.735	46.772	46.809	46.847	46.884	46.921	46.958	46.995
650	27.025	27.067	27.109	27.152	27.194	27.236	27.278	27.320	27.363	27.405	27.447	1150	46.995	47.033	47.070	47.107	47.144	47.181	47.218	47.256	47.293	47.330	47.367
660	27.447	27.489	27.531	27.574	27.616	27.658	27.700	27.742	27.784	27.826	27.869	1160	47.367	47.404	47.441	47.478	47.515	47.552	47.589	47.626	47.663	47.700	47.737
670	27.869	27.911	27.953	27.995	28.037	28.079	28.121	28.163	28.205	28.247	28.289	1170	47.737	47.774	47.811	47.848	47.884	47.921	47.958	47.995	48.032	48.069	48.105
680	28.289	28.332	28.374	28.416	28.458	28.500	28.542	28.584	28.626	28.668	28.710	1180	48.105	48.142	48.179	48.216	48.252	48.289	48.326	48.363	48.399	48.436	48.473
690	28.710	28.752	28.794	28.835	28.877	28.919	28.961	29.003	29.045	29.087	29.129	1190	48.473	48.509	48.546	48.582	48.619	48.656	48.692	48.729	48.765	48.802	48.838
700	29.129	29.171	29.213	29.255	29.297	29.338	29.380	29.422	29.464	29.506	29.548	1200	48.838	48.875	48.911	48.948	48.984	49.021	49.057	49.093	49.130	49.166	49.202
710	29.548	29.590	29.631	29.673	29.715	29.757	29.798	29.840	29.882	29.924	29.965	1210	49.202	49.239	49.275	49.311	49.348	49.384	49.420	49.456	49.493	49.529	49.565
720	29.965	30.007	30.049	30.090	30.132	30.174	30.216	30.257	30.299	30.341	30.382	1220	49.565	49.601	49.637	49.674	49.710	49.746	49.782	49.818	49.854	49.890	49.926
730	30.382	30.424	30.466	30.507	30.549	30.590	30.632	30.674	30.715	30.757	30.798	1230	49.926	49.962	49.998	50.034	50.070	50.106	50.142	50.178	50.214	50.250	50.286
740	30.798	30.840	30.881	30.923	30.964	31.006	31.047	31.089	31.130	31.172	31.213	1240	50.286	50.322	50.358	50.393	50.429	50.465	50.501	50.537	50.572	50.608	50.644
750	31.213	31.255	31.296	31.338	31.379	31.421	31.462	31.504	31.545	31.586	31.628	1501	50.644	50.680	50.715	50.751	50.787	50.822	50.858	50.894	50.929	50.965	51.000
760	31.628	31.669	31.710	31.752	31.793	31.834	31.876	31.917	31.958	32.000	32.041	1260	51.000	51.036	51.071	51.107	51.142	51.178	51.213	51.249	51.284	51.320	51.355
770	32.041	32.082	32.124	32.165	32.206	32.247	32.289	32.330	32.371	32.412	32.453	1270	51.355	51.391	51.426	51.461	51.497	51.532	51.567	51.603	51.638	51.673	51.708
780	32.453	32.495	32.536	32.577	32.618	32.659	32.700	32.742	32.783	32.824	32.865	1280	51.708	51.744	51.779	51.814	51.849	51.885	51.920	51.955	51.990	52.025	52.060
790	32.865	32.906	32.947	32.988	33.029	33.070	33.111	33.152	33.193	33.234	33.275	1290	52.060	52.095	52.130	52.165	52.200	52.235	52.270	52.305	52.340	52.375	52.410
800	33.275	33.316	33.357	33.398	33.439	33.480	33.521	33.562	33.603	33.644	33.685	1300	52.410	52.445	52.480	52.515	52.550	52.585	52.620	52.654	52.689	52.724	52.759
810	33.685	33.726	33.767	33.808	33.848	33.889	33.930	33.971	34.012	34.053	34.093	1310	52.759	52.794	52.828	52.863	52.898	52.932	52.967	53.002	53.037	53.071	53.106
820	34.093	34.134	34.175	34.216	34.257	34.297	34.338	34.379	34.420	34.460	34.501	1320	53.106	53.140	53.175	53.210	53.244	53.279	53.313	53.348	53.382	53.417	53.451
830	34.501	34.542	34.582	34.623	34.664	34.704	34.745	34.786	34.826	34.867	34.908	1330	53.451	53.486	53.520	53.555	53.589	53.623	53.658	53.692	53.727	53.761	53.795
840	34.908	34.948	34.989	35.029	35.070	35.110	35.151	35.192	35.232	35.273	35.313	1340	53.795	53.830	53.864	53.898	53.932	53.967	54.001	54.035	54.069	54.104	54.138
850	35.313	35.354	35.394	35.435	35.475	35.516	35.556	35.596	35.637	35.677	35.718	1350	54.138	54.172	54.206	54.240	54.274	54.308	54.343	54.377	54.411	54.445	54.479
860	35.718	35.758	35.798	35.839	35.879	35.920	35.960	36.000	36.041	36.081	36.121	1360	54.479	54.513	54.547	54.581	54.615	54.649	54.683	54.717	54.751	54.785	54.819
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.484	36.524	1370	54.819	54.852	54.886								
880	36.524	36.564	36.604	36.644	36.685	36.725	36.765	36.805	36.845	36.885	36.925												
890	36.925	36.965	37.006	37.046	37.086	37.126	37.166	37.206	37.246	37.286	37.326												
900	37.326	37.366	37.406	37.446	37.486	37.526	37.566	37.606	37.646	37.686	37.725												
910	37.725	37.765	37.805	37.845	37.885	37.925	37.965	38.005	38.044	38.084	38.124												
920	38.124	38.164	38.204	38.243	38.283	38.323	38.363	38.402	38.442	38.482	38.522												
930	38.522	38.561	38.601	38.641	38.680	38.720	38.760	38.799	38.839	38.878	38.918												
940	38.918	38.958	38.997	39.037	39.076	39.116	39.155	39.195	39.235	39.274	39.314												
950	39.314	39.353	39.393	39.432	39.471	39.511	39.550	39.590	39.629	39.669	39.708												
960	39.708	39.747	39.787	39.826	39.866	39.905	39.944	39.984	40.023	40.062	40.101												
970	40.101	40.141	40.180	40.219	40.259	40.298	40.337	40.376	40.415	40.455	40.494												
980	40.494	40.533	40.572	40.611	40.651	40.690	40.729	40.768	40.807	40.846	40.885												
990	40.885	40.924	40.963	41.002																			



Type T Thermocouples

Thermoelectric Voltage in Millivolts

Incremental degrees in Celsius

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	°C	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
-270	-6.258											0	0.000	0.039	0.078	0.117	0.156	0.195	0.234	0.273	0.312	0.352	0.391
-260	-6.232	-6.236	-6.239	-6.242	-6.245	-6.248	-6.251	-6.253	-6.255	-6.256	-6.258	10	0.391	0.431	0.470	0.510	0.549	0.589	0.629	0.669	0.709	0.749	0.790
-250	-6.180	-6.187	-6.193	-6.198	-6.204	-6.209	-6.214	-6.219	-6.223	-6.228	-6.232	20	0.790	0.830	0.870	0.911	0.951	0.992	1.033	1.074	1.114	1.155	1.196
												30	1.196	1.238	1.279	1.320	1.362	1.403	1.445	1.486	1.528	1.570	1.612
-240	-6.105	-6.114	-6.122	-6.130	-6.138	-6.146	-6.153	-6.160	-6.167	-6.174	-6.180	40	1.612	1.654	1.696	1.738	1.780	1.823	1.865	1.908	1.950	1.993	2.036
-230	-6.007	-6.017	-6.028	-6.038	-6.049	-6.059	-6.068	-6.078	-6.087	-6.096	-6.105	50	2.036	2.079	2.122	2.165	2.208	2.251	2.294	2.338	2.381	2.425	2.468
-220	-5.888	-5.901	-5.914	-5.926	-5.938	-5.950	-5.962	-5.973	-5.985	-5.996	-6.007	60	2.468	2.512	2.556	2.600	2.643	2.687	2.732	2.776	2.820	2.864	2.909
-210	-5.753	-5.767	-5.782	-5.795	-5.809	-5.823	-5.836	-5.850	-5.863	-5.876	-5.888	70	2.909	2.953	2.998	3.043	3.087	3.132	3.177	3.222	3.267	3.312	3.358
-200	-5.603	-5.619	-5.634	-5.650	-5.665	-5.680	-5.695	-5.710	-5.724	-5.739	-5.753	80	3.358	3.403	3.448	3.494	3.539	3.585	3.631	3.667	3.722	3.768	3.814
												90	3.814	3.860	3.907	3.953	3.999	4.046	4.092	4.138	4.185	4.232	4.279
-190	-5.439	-5.456	-5.473	-5.489	-5.506	-5.523	-5.539	-5.555	-5.571	-5.587	-5.603	100	4.279	4.325	4.372	4.417	4.466	4.513	4.561	4.608	4.655	4.702	4.750
-180	-5.261	-5.279	-5.297	-5.316	-5.334	-5.351	-5.369	-5.387	-5.404	-5.421	-5.439	110	4.750	4.798	4.845	4.893	4.941	4.988	5.036	5.084	5.132	5.180	5.228
-170	-5.070	-5.089	-5.109	-5.128	-5.148	-5.167	-5.186	-5.205	-5.224	-5.242	-5.261	120	5.228	5.277	5.325	5.373	5.422	5.470	5.519	5.567	5.616	5.665	5.714
-160	-4.865	-4.886	-4.907	-4.928	-4.949	-4.969	-4.989	-5.010	-5.030	-5.050	-5.070	130	5.714	5.763	5.812	5.861	5.910	5.959	6.008	6.057	6.107	6.156	6.206
-150	-4.648	-4.671	-4.693	-4.715	-4.737	-4.759	-4.780	-4.802	-4.823	-4.844	-4.865	140	6.206	6.255	6.305	6.355	6.404	6.454	6.504	6.554	6.604	6.654	6.704
												150	6.704	6.754	6.805	6.855	6.905	6.956	7.006	7.057	7.107	7.158	7.209
-140	-4.419	-4.443	-4.466	-4.489	-4.512	-4.535	-4.558	-4.581	-4.604	-4.626	-4.648	160	7.209	7.260	7.310	7.361	7.412	7.463	7.515	7.566	7.617	7.668	7.720
-130	-4.177	-4.202	-4.226	-4.251	-4.275	-4.300	-4.324	-4.348	-4.372	-4.395	-4.419	170	7.720	7.771	7.823	7.874	7.926	7.977	8.029	8.081	8.133	8.185	8.237
-120	-3.923	-3.949	-3.975	-4.000	-4.026	-4.052	-4.077	-4.102	-4.127	-4.152	-4.177	180	8.237	8.289	8.341	8.393	8.445	8.497	8.550	8.602	8.654	8.707	8.759
-110	-3.657	-3.684	-3.711	-3.738	-3.765	-3.791	-3.818	-3.844	-3.871	-3.897	-3.923	190	8.759	8.812	8.865	8.917	8.970	9.023	9.076	9.129	9.182	9.235	9.288
-100	-3.379	-3.407	-3.435	-3.463	-3.491	-3.519	-3.547	-3.574	-3.602	-3.629	-3.657	200	9.288	9.341	9.395	9.448	9.501	9.555	9.608	9.662	9.715	9.769	9.822
												210	9.822	9.876	9.930	9.984	10.038	10.092	10.146	10.200	10.254	10.308	10.362
-90	-3.089	-3.118	-3.148	-3.177	-3.206	-3.235	-3.264	-3.293	-3.322	-3.350	-3.379	220	10.362	10.417	10.471	10.525	10.579	10.634	10.689	10.743	10.798	10.853	10.907
-80	-2.788	-2.818	-2.849	-2.879	-2.910	-2.940	-2.970	-3.000	-3.030	-3.059	-3.089	230	10.907	10.962	11.017	11.072	11.127	11.182	11.237	11.292	11.347	11.403	11.458
-70	-2.476	-2.507	-2.539	-2.571	-2.602	-2.633	-2.664	-2.695	-2.726	-2.757	-2.788	240	11.458	11.513	11.569	11.624	11.679	11.735	11.791	11.846	11.902	11.958	12.013
-60	-2.153	-2.186	-2.218	-2.251	-2.283	-2.316	-2.348	-2.380	-2.412	-2.444	-2.476	250	12.013	12.069	12.125	12.181	12.237	12.293	12.349	12.405	12.461	12.518	12.574
-50	-1.819	-1.853	-1.887	-1.920	-1.954	-1.987	-2.021	-2.054	-2.087	-2.120	-2.153	260	12.574	12.630	12.687	12.743	12.800	12.856	12.912	12.969	13.026	13.082	13.139
												270	13.139	13.196	13.253	13.310	13.367	13.423	13.480	13.537	13.595	13.652	13.709
-40	-1.475	-1.510	-1.545	-1.579	-1.614	-1.648	-1.683	-1.717	-1.751	-1.785	-1.819	280	13.709	13.766	13.823	13.881	13.938	13.995	14.053	14.110	14.168	14.226	14.283
-30	-1.121	-1.157	-1.192	-1.228	-1.264	-1.299	-1.335	-1.370	-1.405	-1.440	-1.475	290	14.283	14.341	14.399	14.456	14.514	14.572	14.630	14.688	14.746	14.804	14.862
-20	-0.757	-0.794	-0.830	-0.867	-0.904	-0.940	-0.976	-1.013	-1.049	-1.085	-1.121	300	14.862	14.920	14.978	15.036	15.094	15.153	15.211	15.270	15.328	15.386	15.445
-10	-0.383	-0.421	-0.459	-0.496	-0.534	-0.571	-0.608	-0.646	-0.683	-0.720	-0.757	310	15.445	15.503	15.562	15.621	15.680	15.738	15.797	15.856	15.914	15.973	16.032
0	-0.000	-0.039	-0.077	-0.116	-0.154	-0.193	-0.231	-0.269	-0.307	-0.345	-0.383	320	16.032	16.091	16.150	16.209	16.268	16.327	16.387	16.446	16.505	16.564	16.624
												330	16.623	16.683	16.742	16.802	16.862	16.921	16.980	17.040	17.100	17.159	17.219
												340	17.219	17.279	17.339	17.399	17.458	17.518	17.578	17.638	17.698	17.759	17.819
												350	17.819	17.879	17.939	17.999	18.059	18.119	18.179	18.239	18.299	18.359	18.419
												360	18.422	18.483	18.543	18.604	18.665	18.725	18.786	18.847	18.908	18.969	19.030
												370	19.030	19.091	19.152	19.213	19.273	19.334	19.395	19.456	19.517	19.578	19.641
												380	19.641	19.702	19.763	19.824	19.885	19.946	20.007	20.068	20.129	20.190	20.251
												390	20.255	20.317	20.378	20.440	20.501	20.563	20.625	20.687	20.748	20.810	20.872
												400	20.872										

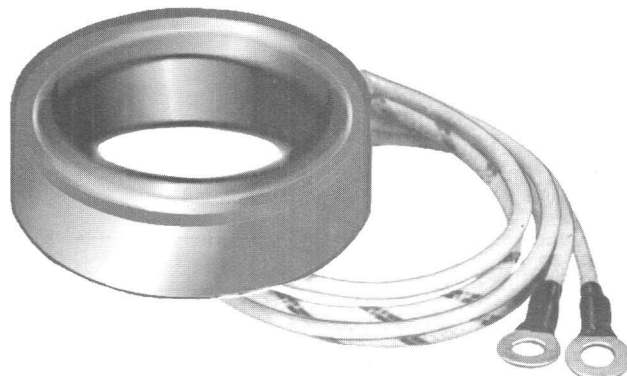
Thermoelectric voltage as a function temperature (°C), reference junctions at 0°C



Accessories

Donut Current Transformers

- Meets A.S.A. C57.13 Standard
- Manufactured to Meet UL Requirements UL1244
- Flexible Leads are UL105, 105° C CSA Approved
- Molded From Impact and Abrasive Resistance Black Nylon for Rugged Construction



A donut transformer is commonly used when current levels to be monitored exceed 75 Amperes. Current transformers rated 100:5 will provide a secondary current of 5 Amperes when a single primary turn is passed through the donut with a 100 Ampere load. The donut transformer provides additional isolation from the line and eliminates the need to break into the conductor. The secondary leads are 2 feet long and may be extended up to 10 feet using at least 12 gauge copper wire. If the distance is greater than ten feet, please consult the factory.

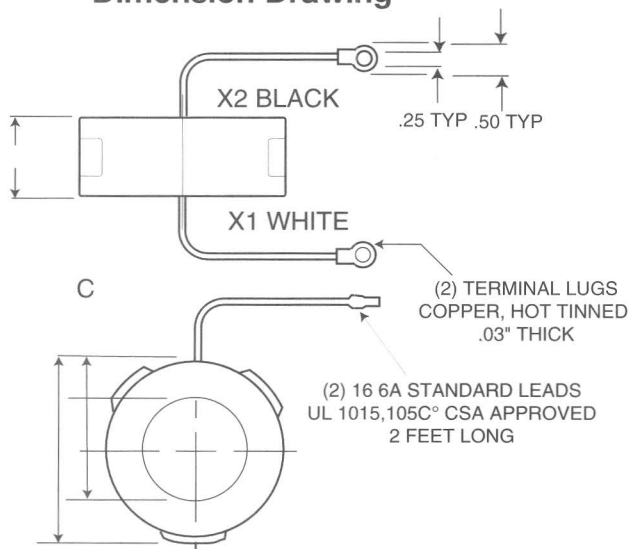
A 50:5 Amp donut is the lowest rating that Simpson normally carries. A donut can be used for ratings below 50 Amps by wrapping either the primary wire passing through the core, or by wrapping the secondary wires leading to the meter. This is shown on the next page.

Other ratings are available on special order. Call the factory with your specifications.

Catalog Number	Turns Ratio	Accuracy For 2 VA Burden
01293	10:1	2%
01306	15:1	2%
01297	20:1	1%
01298	30:1	1%
01299	40:1	1%
01313	50:1	.8%
01300	60:1	.6%
01305	80:1	.5%
01301	100:1	.5%
02303	120:1	.5%
02459	150:1	.3%
02304	200:1	.3%

Dimensions and Ordering Information

Dimension Drawing



NOTE: PRIMARY AND SECONDARY TURN RATIO MODIFICATIONS ARE NOTED ON REVERSE SIDE OF PAGE.

Ordering Information

Ampere		Turns Ratio	Catalog Number	Dimensions		
Primary	Secondary			A	B	C
50	5	10:1	01293	3.56	1.56	3.56
75	5	15:1	01306			
100	5	20:1	01297			
150	5	30:1	01298	3.50	2.06	2.06
200	5	40:1	01299			
250	5	50:1	01313			
300	5	60:1	01300			
400	5	80:1	01305			
500	5	100:1	01301			
600	5	120:1	02303	4.50	3.50	4.50
750	5	150:1	02459			
1000	5	200:1	02304			



Primary Turn Ratio Modification

Formula: $K_a = K_n \times N_n / N_a$

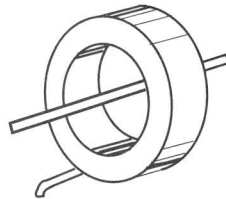
Where: K_a = Actual Transformer Ratio
 K_n = Nameplate Transformer Ratio
 N_a = Actual Number of Primary Turns
 N_n = Nameplate Number of Primary Turns

The ratio of the current transformer can be modified by adding more primary turns to the transformer. By adding primary turns, the current required to maintain five amps on the secondary is reduced.

Example: A 100:5 current transformer designed for one primary turn.

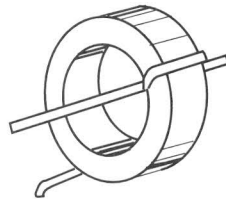
1 Primary Turn

NAMEPLATE RATIO	ACTUAL RATIO
100:5	100:5



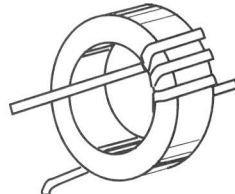
2 Primary Turns

NAMEPLATE RATIO	ACTUAL RATIO
100:5	50:5



4 Primary Turns

NAMEPLATE RATIO	ACTUAL RATIO
100:5	25:5



Secondary Turn Ratio Modification

Formula: $\frac{I_p}{I_s} = \frac{N_s}{N_p}$

Where: I_p - Primary Current
 I_s - Secondary Current
 N_p - Number of Primary Turns
 N_s - Number of Secondary Turns

Example: A 300:5 Current Transformer.

$$\frac{300p}{5s} = \frac{60s}{1p}$$

(In practicality one turn is dropped from the secondary as a ratio correction factor.)

The ratio of the current transformer can be modified by altering the number of secondary turns by forward or backwinding the secondary lead through the window of the current transformer.

By adding secondary turns, the same primary current will result in a decrease in secondary output. By subtracting secondary turns, the same primary current will result in greater secondary output.

Again using the 300:5 example adding five secondary turns will require 325 amps on the primary to maintain the 5 amp secondary output or

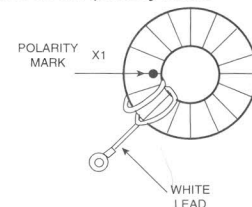
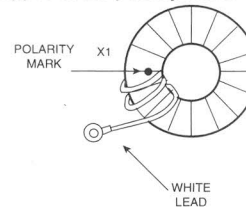
$$\frac{325p}{5s} = \frac{65s}{1p}$$

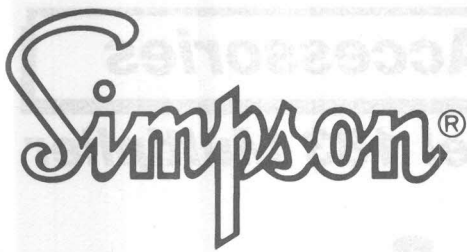
Deducting 5 secondary turns will only require 275 amps on the primary to maintain the 5 amp secondary output or

$$\frac{275p}{5s} = \frac{55s}{1p}$$

The above ratio modifications are achieved in the following manner:

- To add secondary turns, the white lead should be wound through the CT from the side opposite the polarity mark.
- To subtract secondary turns, the white lead should be wound through the CT from the same side as the polarity mark.

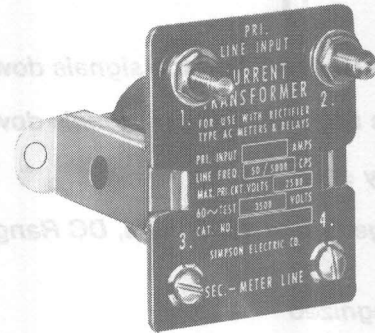




Accessories

Model 186 Current Transformer

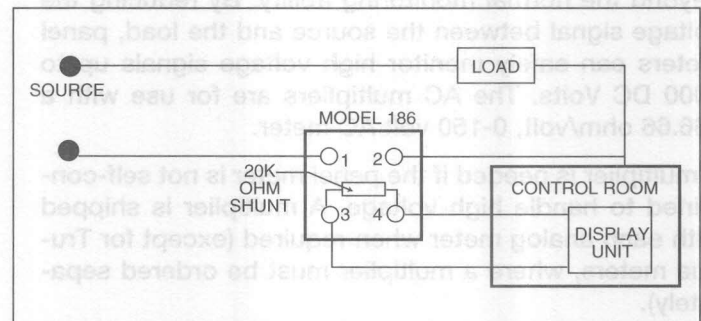
- **Optimal for Remote Sensing of Current Signals.**
- **Converts Current Signal to 0-10 Volt Signal**
- **For use with Rectifier Type Analog Panel Meters or Digital Indicators.**
- **Perfect for Low Current Measurement Where a Donut Current Transformer would not Sense a Signal.**
- **UL Recognized**



The model 186 current transformer converts a current signal to a 0-10 AC Volt signal. This signal can be easily transmitted to a remote location with little Voltage drop. The VA rating of a typical Donut Current Transformer allows only about 15 feet of wire between Donut and display unit. By converting the current signal to a voltage signal, the line loss to the display unit becomes a negligible factor over a greater distance. These units are also about a third of the price compared to transmitters that amplify and isolate a current signal.

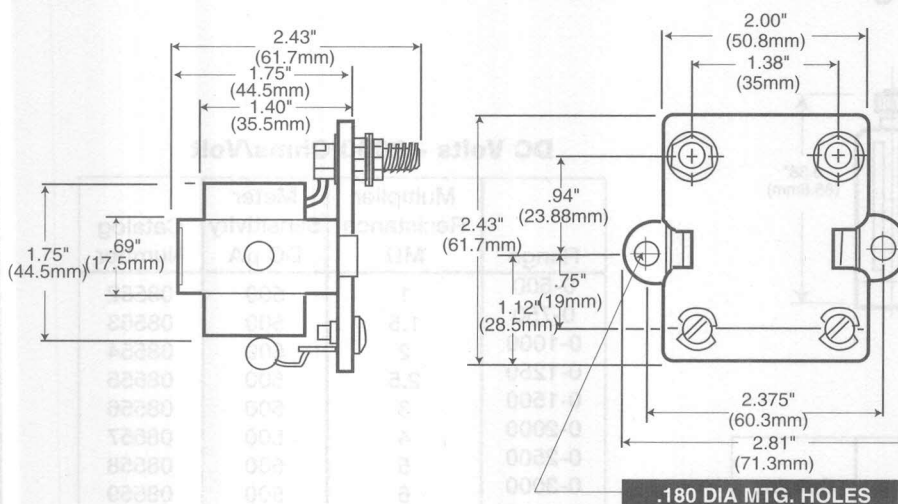
Analog rectifier type meters can have custom dials installed to display the current value of the transformer. A digital display meter can be scaled to the current value easily, but a 20,000 ohm shunt is required across the secondary of the current transformer for accuracy to be maintained.

A typical wiring setup is shown below interconnecting a digital display unit. A 20,000 ohm shunt is wired across the secondary of the Model 186 Current Transformer for proper functioning.



Dimensions and Ordering Information

Dimension Drawing



NOTES:

1. Accuracy readout of transmitter and meter @ 25°C with sinusoidal input is P/M 4% of F.S.
2. Operating temperature range is 140°F to -22°F (60°C to -30°C).

Ordering Information

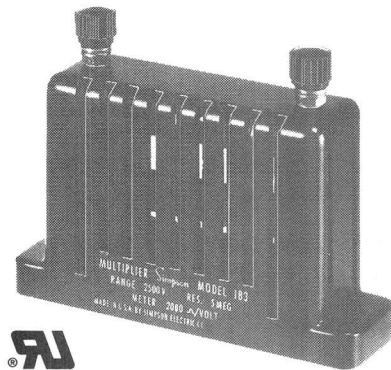
Range	VA	Catalog Number
0-50 mA	0.40	01294
0-100 mA	0.50	01295
0-200 mA	0.37	01296
0-300 mA	0.48	01303
0-500 mA	0.53	01304
0-750 mA	0.37	01307
0-1 Amp	0.42	01308
0-2 Amp	0.54	01309
0-3 Amp	0.66	01311
0-5 Amp	0.75	01312
0-10 Amp	1.45	01314
0-15 Amp	1.05	01315
0-20 Amp	1.04	01316
0-25 Amp	1.50	01317
0-30 Amp	1.10	01318
0-40 Amp	1.09	01319
0-50 Amp	1.90	01321



Accessories

Model 183 Multiplier

- Reduces High AC Voltage signals down to 150 VAC
- Reduces High DC Voltage signals down to 500 μ A
- Accuracy $\pm 1\%$
- AC Ranges up to 1000 Volts, DC Ranges up to 5000 Volts
- UL Recognized



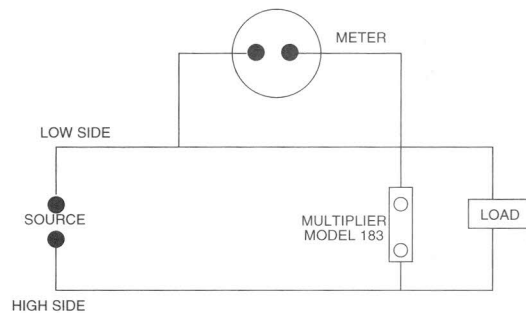
Multipliers increase the capability of the panel meter beyond the normal monitoring ability. By reducing the voltage signal between the source and the load, panel meters can safely monitor high voltage signals up to 5000 DC Volts. The AC multipliers are for use with a 166.66 ohm/volt, 0-150 volt AC meter.

A multiplier is needed if the panel meter is not self-contained to handle high voltage. A multiplier is shipped with each analog meter when required (except for Tru-View meters, where a multiplier must be ordered separately).

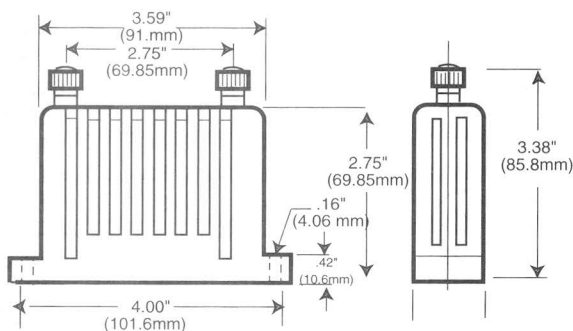
A typical wiring diagram shown to the right depicts the Model 183 installed in series with the meter on the high side of the line and the meter at ground potential. The

multiplier must be installed in an inaccessible location, such as behind the panel or inside an enclosure to prevent access to the high voltage.

DC Voltage — With External Multiplier Model



Dimensions and Ordering



AC Volts - 166 Ohms/Volt

Range	Impedance Ω at 60 Hz.	Voltage Reduced	Voltage Drop	Catalog Number
0-500	58,333	350	150	08562
0-600	75,000	450	150	08563
0-750	100,000	600	150	08564
0-1000	141,666	850	150	08565

DC Volts - 2000 Ohms/Volt

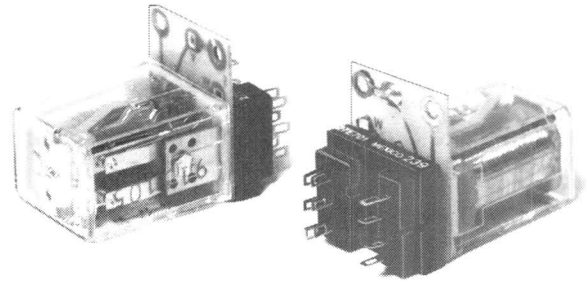
Range	Multiplier Resistance $M\Omega$	Meter Sensitivity DC μ A	Catalog Number
0-500	1	500	08552
0-750	1.5	500	08553
0-1000	2	500	08554
0-1250	2.5	500	08555
0-1500	3	500	08556
0-2000	4	500	08557
0-2500	5	500	08558
0-3000	6	500	08559
0-4000	8	500	08560
0-5000	10	500	08561



Accessories

Meter Relays For 3600 Series

- Enables Edgewise Controllers to Function as a Meter/Relay Controller.
- Single DPDT Relay Rated 5 Amps at 120 VAC on Each Pole.
- 1,000,000 Operations at Rated Load.
- Two Relays Can Be Used On Dual Setpoint Controllers.
- Edge Connector Provided



The plug-in electromechanical relay module allows the Edgewise Controllers to function as On-Off controllers. The relay kit is directly interchangeable with the Opto-Isolated Zero Crossing Triac Module (catalog number 16899).

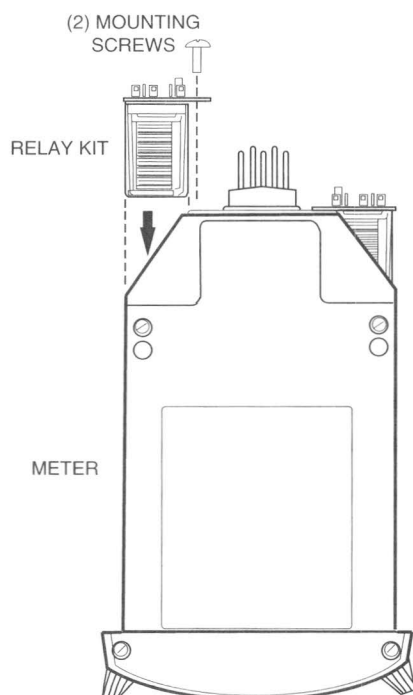
The relays are connected for automatic reset when they are shipped from the factory. The state of the relays can be changed to remain de-energized when the signal is removed by following the procedure to the right. In this state, the relays require manual resetting.

De-Energized Relay Condition

If you want the relay to remain de-energized when the signal is removed, follow this procedure. Make sure the unit is disconnected from any power or signal source.

- 1) Unsolder the strap from terminals S to A and resolder S to M.
- 2) Connect Terminals 10 to 4.
- 3) Connect a normally open (N.O.) switch between terminals 9 and 10.
- 4) To energize the relay, a coil signal must be present, then momentarily actuate the N.O. switch.
- 5) When the coil signal is removed, the relay will de-energize until it is manually reset.

Wiring and Ordering Information

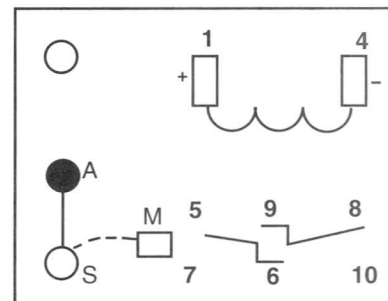


SPECIFICATIONS

Rated Circuit-to-Ground Voltage: 130 VRMS Max.

Contact Rating: 5A @ 28VDC/115VAC

Coil: 700 Ω Pull-in @ 18VDC



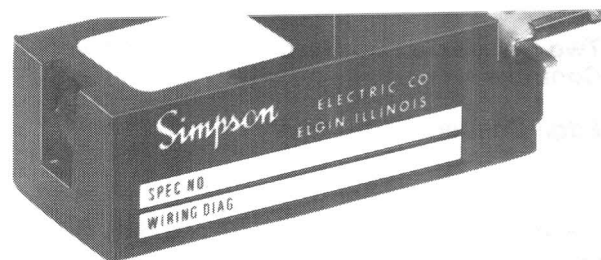
Ordering Information

Catalog Number: 16898

■ Normally Open SPST Unit.

The Opto-Isolated Zero Crossing Triac Module is to be used with the 3600 series controller, and is directly interchangeable with the electromechanical relay kit (catalog number 16898). The Triac module is suitable for use in applications where a solid state triac module is preferred to an electromechanical relay.

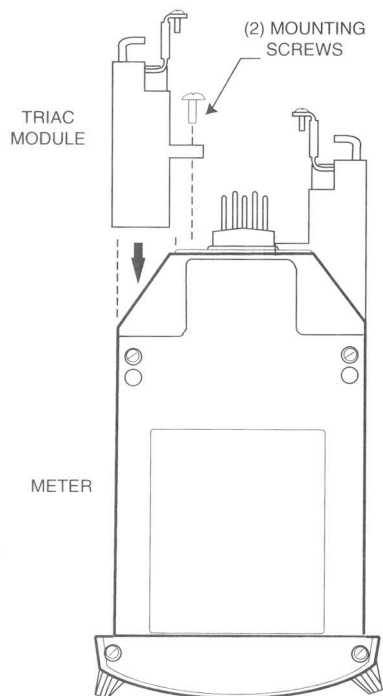
The Triac module provides opto-isolation of the signal input from the load circuits. The load becomes energized only when the input signal is applied, and the line voltage waveform crosses zero. The load becomes de-energized only when the input signal is absent and the line voltage waveform again crosses zero. This method effectively eliminates switching R.F.I.



WARNING

This Triac Module is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, the owners manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

Wiring and Ordering Information



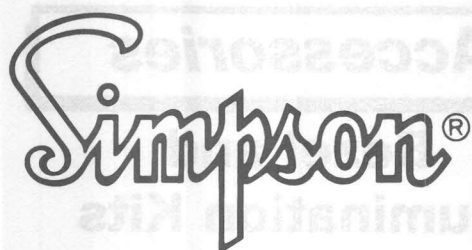
SPECIFICATIONS

Rated Circuit-to-Ground Voltage: 250 VRMS Max.

The triac module will provide up to 4 Amps @ 115 VAC @ 25°C, or 2 Amps @ 115 VAC @ 50°C.

Ordering Information

Catalog Number: 16899



Accessories

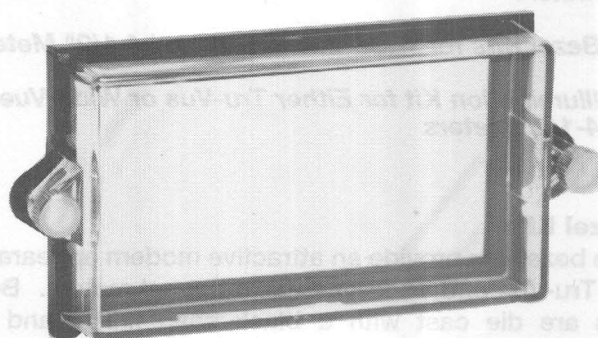
1/8 DIN Nema 4 Removable Cover

- Protects 1/8 DIN Indicators and Controllers
- Dust Tight and Water Tight to Nema 4 Standards.
- Easy Installation
- Front Removable Cover, Allowing Access to the Programming Buttons of a Controller, or the Scaling Potentiometers of an Indicator.

This cover protects all of Simpson's 1/8 DIN panel indicators/controllers to NEMA-4 standards. Type 4 enclosures are intended for indoor use to protect the enclosed equipment against splashing water, falling or hose directed water, severe external condensation, and are dust tight.

The cover is composed of a steel bezel with integral neoprene gaskets on each side. The lens is made of polycarbonate, and screws into the bezel and compresses the internal gasket. When properly installed, the two gaskets and steel bezel provide a water tight and dust tight seal for the panel instrument.

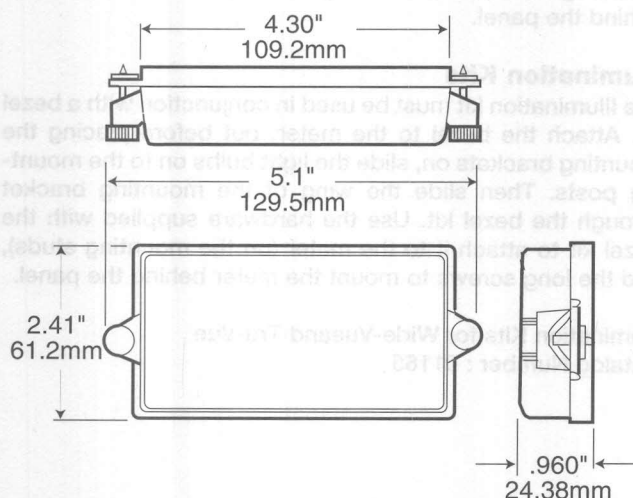
To install the Nema 4 cover, separate the bezel from the removable cover. Slide the bezel on to the meter, and then install the meter into the panel cutout. This will



compress the rear gasket on the bezel. The inner gasket is partially compressed by the meter bezel itself. Attach the cover to the bezel, screwing it tight to compress the inner gasket. The front seal is then water and dust tight, and the enclosure meets Nema 4 standards.

The front cover can easily be removed by unscrewing the two side knobs. This allows easy access to programming buttons, potentiometers, or jumpers.

Dimensions and Ordering Information



Ordering Information

Catalog Number: 45003

Specifications

Lens Material:	Clear 94V-0 UL-rated polycarbonate with UV inhibitor
Gasket Material:	Closed Cell Neoprene
Bezel Material:	Steel
Bezel Finish:	Black Polyurethane
Bezel Dimensions (W x H x D):	4.3" x 2.41" x 0.28" (109.2mm x 61.2mm x 7.1mm)
Overall Dimensions (W x H x D):	4.3" x 2.41" x 0.96" (109.2mm x 61.2mm x 24.4mm)
Panel Cutout (W x H):	3.66" X 1.79" (93mm x 45.5mm)



Accessories

Bezel and Illumination Kits

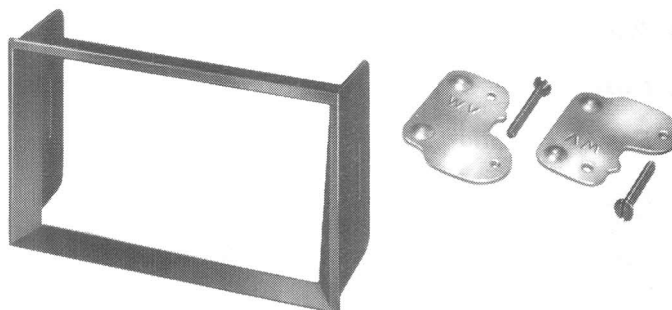
- Bezel Kits for Tru-View 3-1/2", 4-1/2", and 4 x 6" Meters
- Bezel Kits for Wide-View 3-1/2" and 4-1/2" Meters
- Illumination Kit for Either Tru-View or Wide-View 4-1/2" Meters

Bezel Kits

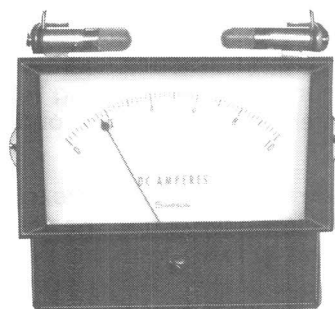
The bezel kits provide an attractive modern appearance for Tru-View and Wide-View analog panel meters. Bezel kits are die cast with a black satin finish, and are designed for behind panel mounting. The bezel kits can accommodate a panel thickness from 1/8" to 3/16". Bezel kits include all mounting hardware required.

Illumination Kits

Illumination kits are available for the 4-1/2" bezel kits. These kits must be used with a bezel kit. A pair of 6.3 Volt bulbs, 0.25 Amps, are mounted above the meter behind the panel. The kit illuminates the meter face for ease of reading in dark areas.



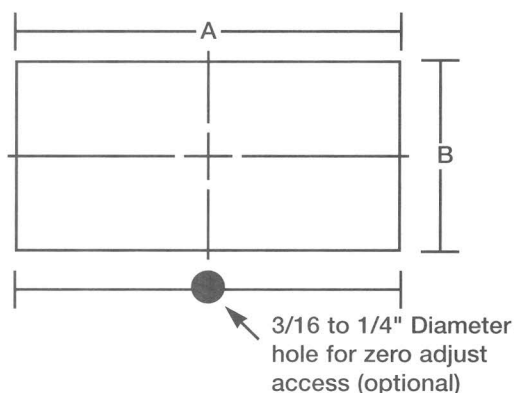
Tru-View Bezel Kit



Illumination and Bezel Kit Attached to Meter

Dimensions and Ordering

Bezel Kits



Size	Panel Cutout		Catalog Number
	A	B	
Tru-View 3-1/2"	3.594"	2.032"	TV3BK
4-1/2"	4.812"	2.750"	TV4BK
4" x 6"	6.156"	3.094"	TV6BK
Wide-View 3-1/2"	3.406"	2.094"	01253
4-1/2"	4.812"	2.750"	01123

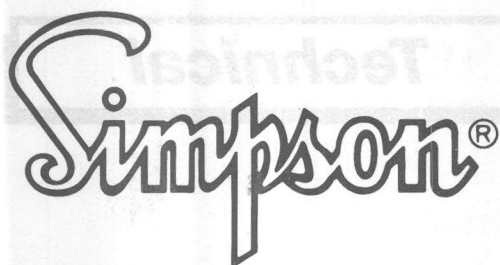
Bezel Kits

Slide the bezel kit on the front of the meter. Place the mounting brackets around the mounting studs of the meter, and slide the wing through the bezel kit. Use the hardware supplied with the bezel kit to attach it to the meter (on the mounting studs), and the long screws to mount the meter behind the panel.

Illumination Kits

The Illumination kit must be used in conjunction with a bezel kit. Attach the bezel to the meter, but before placing the mounting brackets on, slide the light bulbs on to the mounting posts. Then slide the wing of the mounting bracket through the bezel kit. Use the hardware supplied with the bezel kit to attach it to the meter (on the mounting studs), and the long screws to mount the meter behind the panel.

Illumination Kits for Wide-View and Tru-View
Catalog Number : 01165



Electricity

Ohm's Law	F1
Ohm's Law Variations	F1
General Formulas	F1
Amperage Conversion Chart	F2
Additional Formulas	F2
Engineering Constants and Conversions	F3

Temperature

Centigrade-Fahrenheit Conversion	F3
Thermometer Chart	F3
General Formulas	F4

General Conversion Tables

Linear Measure	F4
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Electricity

OHM'S LAW

Volts (V)	Ohms (R)	Amperes (I)	Watts (W)
$V = IR$	$R = V / I$	$I = V / R$	$W = VI$
$V = \sqrt{WR}$	$R = V^2 / W$	$I = W / V$	$W = I^2 R$
$V = W / I$	$R = W / I^2$	$I = \sqrt{W / R}$	$W = V^2 / R$

OHM'S LAW VARIATIONS

Watts

Watts = Amperes² × Ohms

Watts = Volts × Amperes

Wattage varies directly as ratio of voltages squared

$$W_2 = W_1 \times \frac{E_2^2}{E_1^2}$$

$$\text{Watts} = \frac{\text{Volts}^2}{\text{Ohms}}$$

Total Watts

Ohms

$$\text{Ohms} = \frac{\text{Volts}}{\text{Amperes}}$$

$$\text{Ohms} = \frac{\text{Volts}^2}{\text{Watts}}$$

$$\text{Ohms} = \frac{\text{Watts}}{\text{Amperes}^2}$$

Volts

$$\text{Volts} = \sqrt{\text{Watts} \times \text{Ohms}}$$

$$\text{Volts} = \frac{\text{Watts}}{\text{Amperes}}$$

$$\text{Volts} = \text{Amperes} \times \text{Ohms}$$

Amperes

$$\text{Amperes} = \frac{\text{Volts}}{\text{Ohms}}$$

$$\text{Amperes} = \frac{\text{Watts}}{\text{Volts}}$$

$$\text{Amperes} = \sqrt{\frac{W}{R}}$$

Square Measure	F4
Cubic Measure	F5
Liquid Measure	F5
Weights	F5
Volume	F5
Area	F6
Density	F6
Speed/Velocity	F6
Volmetric Flow Rate	F6
Pressure	F6

Decibel Table	F7
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IP Protection Classification System	F8
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GENERAL FORMULAS

Electricity

1 ampere = 1 coulomb per second

1 volt = 1 joule per coulomb

Ohm's Law: Current = $\frac{\text{potential difference}}{\text{resistance}}$

or amperes = $\frac{\text{volts}}{\text{ohms}}$ or $I = \frac{V}{R}$

Ampere = electric current

Volt = potential difference

Ohm = electrical resistance

One volt potential difference will drive 1 ampere through a resistance of 1 ohm.

The resistance of conductor can be calculated by the formula:

$$R = \frac{kl}{d^2} \quad (\text{Where } l \text{ is length, } d \text{ is diameter, and } k \text{ is constant})$$

The combined resistance of conductors connected in parallel is:

$$\frac{1}{R_c} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

1 watt is the power of a current of 1 ampere when the potential difference is 1 volt.

To compute electric power: P (power in watts) = V (voltage in volts) × I (current in amperes), or $P = V \times I$.

To compute the heat: (H), produced by a current (I), through a resistance (R), in a time (t), use the equation: $H = I^2 \times R \times t \times 0.24 \text{ cal/watt-sec.}$



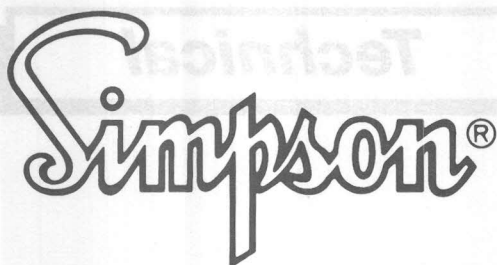
AMPERAGE CONVERSION

Watts	Volts Single Phase			Volts 3 Phase Balanced Load		Watts
	120	240	480	240	480	
100	.83	.42	.21	.24	.13	100
150	1.25	.63	.31	.36	.18	150
200	1.67	.83	.42	.49	.25	200
250	2.08	1.04	.52	.61	.30	250
300	2.50	1.25	.63	.73	.37	300
350	2.92	1.46	.73	.85	.43	350
400	3.33	1.67	.84	.97	.49	400
450	3.75	1.88	.93	1.10	.55	450
500	4.17	2.08	1.04	1.20	.60	500
600	5.00	2.50	1.25	1.45	.73	600
700	5.83	2.92	1.46	1.70	.85	700
750	6.25	3.13	1.56	1.81	.91	750
800	6.67	3.33	1.67	1.93	.97	800
900	7.50	3.75	1.87	2.17	1.09	900
1000	8.33	4.17	2.10	2.41	1.21	1000
1100	9.17	4.58	2.30	2.65	1.33	1100
1200	10.0	5.00	2.51	2.90	1.45	1200
1250	10.4	5.21	2.61	3.10	1.55	1250
1300	10.8	5.42	2.71	3.13	1.57	1300
1400	11.7	5.83	2.91	3.38	1.69	1400

Watts	Volts Single Phase			Volts 3 Phase Balanced Load		Watts
	120	240	480	240	480	
1500	12.5	6.25	3.12	3.62	1.82	1500
1600	13.3	6.67	3.34	3.86	1.93	1600
1700	14.2	7.08	3.54	4.10	2.05	1700
1750	14.6	7.29	3.65	4.22	2.10	1750
1800	15.0	7.50	3.75	4.34	2.17	1800
1900	15.8	7.92	3.96	4.58	2.29	1900
2000	16.7	8.33	4.17	4.82	2.41	2000
2200	18.3	9.17	4.59	5.30	2.65	2200
2500	20.8	10.4	5.21	6.10	3.05	2500
2750	23.0	11.5	5.73	6.63	3.32	2750
3000	25.0	12.5	6.25	7.23	3.62	3000
3500	29.2	14.6	7.30	8.45	4.23	3500
4000	33.3	16.7	8.33	9.64	4.82	4000
4500	37.5	18.8	9.38	10.84	5.42	4500
5000	41.7	20.8	10.42	12.1	6.1	5000
6000	50.0	25.0	12.50	14.50	7.25	6000
7000	58.3	29.2	14.59	16.9	8.5	7000
8000	66.7	33.3	16.67	19.3	9.65	8000
9000	75.0	37.5	18.75	21.7	10.85	9000
10000	83.3	41.7	20.85	24.1	12.1	10000

FORMULAS FOR OBTAINING KILOWATTS, KILOVOLTAMPS, HORSEPOWER AND AMPERES

F 2	Wanted	Single Phase	Alternating 2-Phase 4-Phase	Three-Phase	Direct Current
	Kilowatts	$\frac{I \times V \times PF}{1000}$	$\frac{I \times 2 \times PF \times V}{1000}$	$\frac{I \times V \times 1.73 \times PF}{1000}$	$\frac{I \times V}{1000}$
	Kilovoltamps	$\frac{I \times V}{1000}$	$\frac{I \times V \times 2}{1000}$	$\frac{I \times V \times 1.73}{1000}$	$\frac{I \times V}{1000}$
	Horsepower	$\frac{I \times V \times \%Eff. \times PF}{746}$	$\frac{I \times V \times 2 \times \%Eff. \times PF}{746}$	$\frac{I \times V \times 1.73 \times \%Eff. \times PF}{746}$	$\frac{I \times V \times \%Eff.}{746}$
	Amperes from kVA	$\frac{kVA \times 1000}{V}$	$\frac{kVA \times 1000}{2 \times V}$	$\frac{kVA \times 1000}{1.73 \times V}$	$\frac{kVA \times 1000}{V}$
	Amperes from kW	$\frac{kW \times 1000}{V \times PF}$	$\frac{kW \times 1000}{2 \times V \times PF}$	$\frac{kW \times 1000}{1.73 \times V \times PF}$	$\frac{kW \times 1000}{V}$
	Amperes from HP	$\frac{HP \times 746}{V \times \%Eff. \times PF}$	$\frac{HP \times 746}{2 \times V \times \%Eff. \times PF}$	$\frac{HP \times 746}{1.73 \times V \times \%Eff. \times PF}$	$\frac{HP \times 746}{V \times \%Eff.}$
V = Volts I = Amperes %Eff. = Percent Efficiency PF = Power Factor					



ENGINEERING CONSTANTS AND CONVERSIONS

Physical Quantity ...	Multiply By ...	To Convert to ...
British Thermal Units/Hour (BTU/hr.)	.393 x 10 ⁻³	Horsepower (Hp)
British Thermal Units/Hour (BTU/hr.)	.2931	Joules/Second (J/s)
British Thermal Units/Hour (BTU/hr.)	.2931	Watts (W)
Horsepower (Hp)	.746	Kilowatts (KW)
Horsepower (Hp)	2544.4	British Thermal Units/Hour (BTU/hr)
Horsepower (Hp)	746	Joules/Second (J/s)
Joules/Second (J/s)	1	Watts (W)
Joules/Second (J/s)	.001341	Horsepower (Hp)
Joules/Second (J/s)	3.412	British Thermal Units/Hour (BTU/hr)
Kilowatts (KW)	1.341	Horsepower (Hp)
Kilowatts (KW)	1000	Joules/Second (J/s)
Kilowatts (KW)	3412	British Thermal Units/Hour (BTU/hr)
Watts (W)	.001	Kilowatts (KW)
Watts (W)	.001341	Horsepower (Hp)
Watts (W)	1	Joules/Second (J/s)
Watts (W)	3.412	British Thermal Units/Hour (BTU/hr)

Temperature

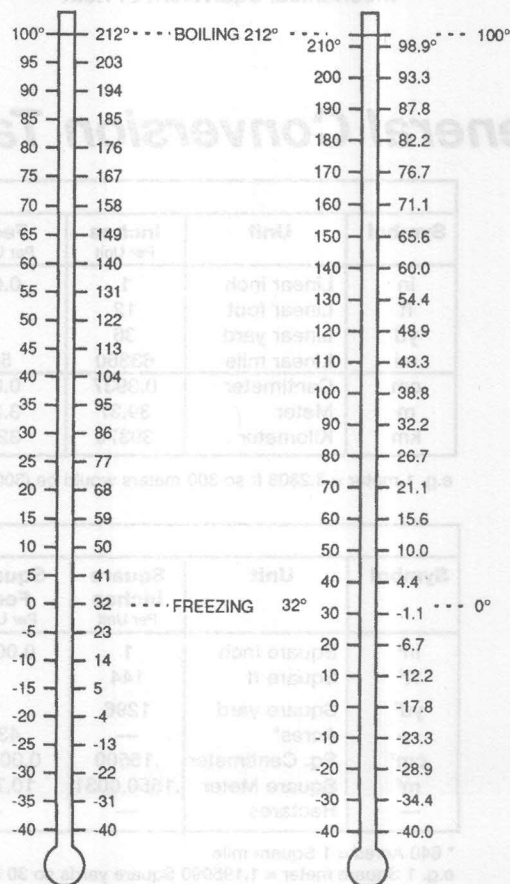
CELSIUS-FAHRENHEIT CONVERSION RATIOS

C	F	C	F	C	F
0	32.0	35	95.0	68	154.4
1	33.8	36	96.8	69	156.2
2	35.6	37	98.6	70	158.0
3	37.4	38	100.4	71	159.8
4	39.2	39	102.2	72	161.6
5	41.0	40	104.0	73	163.4
6	42.8	41	105.8	74	165.2
7	44.6	42	107.6	75	167.0
8	46.4	43	109.4	76	168.8
9	48.2	44	111.2	77	170.6
10	50.0	45	113.0	78	172.4
11	51.8	46	114.8	79	174.2
12	53.6	47	116.0	80	176.0
13	55.4	48	118.4	81	177.8
14	57.2	49	120.2	82	179.6
15	59.0	50	122.0	83	181.4
16	60.8	51	123.8	84	183.2
17	62.6	52	125.6	85	185.0
18	64.4	53	127.4	86	186.8
19	66.2	54	129.2	87	188.6
20	68.0	55	131.0	88	190.1
21	69.8	56	132.8	89	192.2
22	71.6	57	134.6	90	194.0
23	73.4	58	136.4	91	195.8
24	75.2	59	138.2	92	197.6
25	77.0	60	140.0	93	199.4
26	78.8	61	141.8	94	201.2
27	80.6	62	143.6	95	203.0
28	82.4	63	145.4	96	204.0
29	84.2	64	147.2	97	206.6
30	86.0	65	149.0	98	208.4
31	87.8	66	150.8	99	210.2
32	89.6	67	152.6	100	212.0
33	91.4				
34	93.2				

CELSIUS-FAHRENHEIT CONVERSION:
 $F = (C \times 9/5) + 32$ $C = (F - 32) \times 5/9$

Celsius to Fahrenheit

Fahrenheit to Celsius



Centigrade is now rererred to as Celsius. (Note: 212F = 100 C). To convert Centigrade to Fahrenheit: Multiply C by 9/5, then add 32, written F = (9/5 C) +32.

To convert Centigrade to Absolute or Kelvin scale: add 273 to C.

To convert Fahrenheit to Absolute or Kelvin scale: first convert F to C, then add 273.

Boyle's Law: $p_1 \times V_1 = p_2 \times V_2$ at constant temperature. Zero degrees Kelvin is the lowest possible temp.

In Kelvin Absolute temperature scale: water boils at 373K, freezes at 273K.

Boiling point of liquid: that temperature at which the vapor pressure is equal to the pressure above the liquid.

0.427 kilogram-meter (kg-m) = 1 calorie

Work

mechanical equivalent of heat

Combination of Charles' and Boyle's Laws:

$$\frac{V_1 p_1}{T_1} = \frac{V_2 p_2}{T_2}$$

at constant pressure

When heated through one degree Centigrade, any gas expands 1/273 of its volume at 0 degrees Centigrade if the pressure remains constant. One BTU is the heat required to raise the temperature of 1 pound of water through 1 degree Fahrenheit.

One calorie: the heat required to raise the temperature of 1 gram of water through 1 degree Centigrade.

Specific Heat: heat required to raise the temperature of a unit mass of that substance through 1 degree. If H is total heat and M is mass, $H = M \times s \times (t_2-t_1)$.

Heat of melting or heat of fusion, L, is the quantity of heat needed to melt one unit weight of substance without changing its temperature, of $H = M \times L$.

80 calories of heat is required to melt 1 gram of ice without raising its temperature.

General Conversion Tables

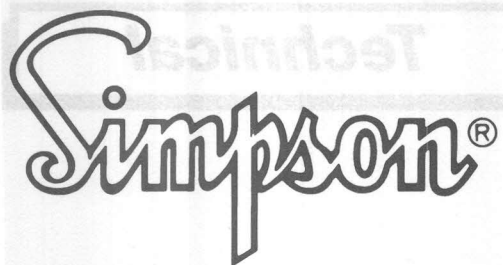
Linear Measure								
Symbol	Unit	Inches Per Unit	Feet Per Unit	Yards Per Unit	Miles Per Unit	Centimeters Per Unit	Meters Per Unit	Kilometers Per Unit
in	Linear inch	1	0.0833	0.027778	—	2.54	0.0254	—
ft	Linear foot	12	1	0.3333	—	30.480	0.3048	—
yd	Linear yard	36	3	1	—	91.44	0.9144	—
mi	Linear mile	63360	5280	1760	1	—	1609.34	1.609
cm	Centimeter	0.3937	0.0328	0.010936	—	1	0.01	—
m	Meter	39.37	3.2808	1.093613	—	100	1	.001
km	Kilometer	39370	3280.8	1093.613	.6214	—	1000	1

e.g. 1 meter = 3.2808 ft so 300 meters would be (300 m) (3.2808 ft/m) = 984.24 ft

Square Measure								
Symbol	Unit	Square Inches Per Unit	Square Feet Per Unit	Square Yards Per Unit	Acres Per Unit	Square Centimeters Per Unit	Square Meters Per Unit	Hectares Per Unit
in²	Square inch	1	0.006944	0.0007716	—	6.4516	0.000645	—
ft²	Square ft	144	1	0.111111	—	929.034	0.0929	—
yd²	Square yard	1296	9	1	—	8361.274	0.836127	—
—	Acres*	—	43560	4840	1	—	4047	0.4047
cm²	Sq. Centimeter	.15500	0.0010764	0.00011960	—	1	0.0001	—
m²	Square Meter	.1550.0031	10.76391	1.195990	—	100000	1	0.0001
—	Hectares	—	—	11954.8	2.47	—	10000	1

* 640 Acres = 1 Square mile

e.g. 1 Square meter = 1.195990 Square yards so 30 Square meters would be (30 m²) (1.195990 yd²/m²) = 35.88 yd²



Cubic Measure						
Symbol	Unit	Cubic Inches Per Unit	Cubic Feet Per Unit	Cubic Yards Per Unit	Cubic Centimeters Per Unit	Square Meters Per Unit
cu in	Cubic in	1	.0005787	.00002143	16.387064	.000016387
cu ft	Cubic ft	1728	1	.037037	28316.847	.018317
cu yd	Cubic yard	46656	27	1	764554.9	.7646
cu cm or cm ³	Cu Centimeter	0.0610237	.0000353	.000001308	1	.000001
cu m or m ³	Cubic meter	61023.74	35.31467	1.307951	1,000,000	1

e.g. 1 m³ = 1.307951 cu yds so 3 cubic meters would be (3 m³) (1.307942 cu yd/m³) = 3.923853 cu yd

Liquid Measure						
Symbol	Unit	Fluid Ounces Per Unit	Pints Per Unit	Quarts Per Unit	Gallons Per Unit	Liters Per Unit
fl oz	Fluid Ounces	1	.0625	.03125	.0078125	.02957
—	Pint	16	1	.5	.125	.4732
l.qt	Quart	32	2	1	.25	.9464
gal	Gallons	128	8	4	1	3.7854
ℓ	Liter	33.814	2.1134	1.0567	.26417	1

e.g. 1 Liter = .26418 Gallons so 4 Liters would be (4ℓ) (.26418 gal/ℓ) = 1.05672 gal

Weights										
Symbol	Unit	Grains Per Unit	Grams Per Unit	Troy Ounces Per Unit	Avoirdupois Ounces Per Unit	Troy Pounds Per Unit	Avoirdupois Pounds Per Unit	Kilograms Per Unit	Troy Tons Per Unit	Avoirdupois Tons Per Unit
gr	Grain	1	.0648	.002083	.002286	.0001736	.0001429	—	—	—
g	Gram	15.4324	1	.032151	.035274	.002679	.002205	.001	—	—
oz. t.	Ounce Troy	480	31.1035	1	1.09715	.083333	.068571	.031103	—	—
oz. av.	Ounce Av.	437.5	28.3495	.911458	1	.075955	.0625	.028350	—	—
lb. t.	Pound Troy	5760	373.242	12	13.1657	1	.822857	.37324	.000411	—
lb. av.	Pound Av.	7000	453.59	14.5833	16	1.215278	1	.45359	.000454	.00050
kg	Kilograms	—	1000	32.1507	35.274	2.67923	1	.001	.001102	—
—	Ton Metric	—	—	32150.7	32574	2679.23	2204.62	1000	1	1.10231
—	Ton Av.	—	—	29166.7	32000	2430.56	2000	907.185	.907185	1

e.g. 1 gram = .032151 troy ounces so 40 grams would be (40 g) (.032151 oz.t./g) = 1.28604 oz. t.

VOLUME

Physical Quantity ...		Multiply By ...	To Convert to ...
Cubic Centimeters	(cm ³)	.061	Cubic Inches (in ³)
Cubic Feet	(ft ³)	.02832	Cubic Meters (m ³)
Cubic Feet	(ft ³)	1728	Cubic Inches (in ³)
Cubic Feet	(ft ³)	7.481	Gallons (gal)
Cubic Inches	(in ³)	16.387	Cubic Centimeters (cm ³)
Cubic Meters	(m ³)	1000	Liters (ℓ)
Cubic Meters	(m ³)	264.18	Gallons (gal)
Cubic Meters	(in ³)	35.31	Cubic Feet (ft ³)
Cubic Millimeters	(mm ³)	61 x 10 ⁻⁶	Cubic Inches (in ³)
Gallons	(gal)	231	Cubic Inches (in ³)
Gallons	(gal)	3.7854	Liters (ℓ)
Liters	(ℓ)	.2642	Gallons (gal)
Liters	(ℓ)	1000	Milliliters (ml)
Milliliters	(ml)	.061	Cubic Inches (in ³)



AREA

Physical Quantity ...	Multiply By ...	To Convert to ...
Cubic Centimeters (cm ³)	.155	Square Inches (in ²)
Cubic Feet (ft ³)	.0929	Square Meters (m ²)
Cubic Inches (in)	6.452	Square Centimeters (cm ²)
Cubic Meters (m ³)	10.76	Square Feet (ft ²)
Cubic Millimeters (mm ³)	.00155	Square Inches (in ²)

DENSITY

Physical Quantity ...	Multiply By ...	To Convert to ...
Grams/Cubic Centimeters (g/cm ³)	1000	Kilograms/Cubic Meter (kg/m ³)
Grams/Cubic Centimeter (g/cm ³)	.03613	Pounds/Cubic Inch (lb/in ³)
Kilograms/Cubic Meter (kg/m ³)	.06243	Pounds/Cubic Foot (lb/ft ³)
Kilograms/Cubic Meter (kg/m ³)	.001	Grams/Cubic centimeter (g/cm ³)
Pounds/Cubic Foot (lb/ft ³)	16.018	Kilograms/Cubic Centimeter (g/cm ³)
Pounds/Cubic Inch (lb/in ³)	.5787 x 10 ⁻³	Pounds/Cubic Foot (lb/ft ³)
Pounds/Cubic Inch (lb/in ³)	27.68	Grams/Cubic Centimeter (g/cm ³)

SPEED/VELOCITY

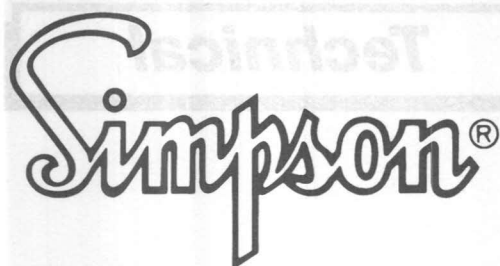
Physical Quantity ...	Multiply By ...	To Convert to ...
Centimeters/Second (cm/s)	.03281	Feet/Second (fps)
Feet/Minute (fpm)	.011364	Miles/Hour (mph)
Feet/Second (fps)	.3048	Meters/Second (m/s)
Meters/Second (m/s)	3.281	Feet/Second (fps)
Miles/Hour (mph)	1.609	Kilometers/Hour (km/hr)
Miles/Hour (mph)	88	Feet/Minute (fpm)

F VOLMETRIC FLOW RATE

Physical Quantity ...	Multiply By ...	To Convert to ...
Cubic Centimeters/Second (cm ³ /s)	60 X 10 ⁻⁶	Cubic Meters/Minute (m ³ /min)
Cubic Feet/Hour (ft ³ /hr)	.12468	Gallons/Minute (gpm)
Cubic Meters/Minute (m ³ /min)	264.18	Gallons/Minute (gpm)
Gallons/Minute (gpm)	.06308	Liters/Second (l/s)
Gallons/Minute (gpm)	.22713	Cubic Meters/Hour (m ³ /hr)

PRESSURE

Physical Quantity ...	Multiply By ...	To Convert to ...
Atmospheres (atm)	1.01325	Bar
Atmospheres (atm)	10,332.3	Kilograms/Square Meter (kg/m ²)
Atmospheres (atm)	101,325	Kilopascals (KPa)
Atmospheres (atm)	14.696	Pounds/Square Inch (psi)
Atmospheres (atm)	29.921	Inches Mercury (in Hg)
Atmospheres (atm)	33.934	Feet of Water (ft H ₂ O)
Atmospheres (atm)	760	Millimeters Mercury (mm Hg)
Atmospheres (atm)	760	Torr ()
Bar (bar)	14.504	Pounds/Square Inch (psi)
Pounds/Square Inch (psi)	703.07	Kilograms/Square Meter (kg/m ²)
Pounds/Square (psi)	.0703	Kilograms/Square Centimeter (kg/cm ²)



Decibel Data

Power Level dB	Power Ratio to 0 dB	Power .006 Watt at 0 dB Watts	Voltage Ratio to 0 dB	Volts — Based on .006 Watt at 0 dB in		Instrument Resistance 5000 at 0 dB	
				500 ohms	600 ohms	Total	Differential
-10	0.1000	0.0006000	0.31623	0.5477	.6000	1581	
-9	0.1259	0.0007553	0.35481	0.6145	.6732	1774	193
-8	0.1585	0.0009509	0.39811	0.6895	.7554	1991	217
-7	0.1995	0.0011972	0.44668	0.7737	.8475	2233	242
-6	0.2512	0.0015071	0.50119	0.8681	.9509	2506	273
-5	0.3162	0.0018975	0.56234	0.9740	1.0670	2812	306
-4	0.3981	0.0023886	0.63096	1.0928	1.1972	3155	343
-3	0.5012	0.0030071	0.70795	1.2262	1.3433	3540	385
-2	0.6310	0.0037857	0.79433	1.3758	1.5071	3972	432
-1	0.7943	0.0047660	0.89125	1.5437	1.6910	4456	484
0	1.0000	0.0060000	1.00000	1.7321	1.8974	5000	544
+1	1.2589	0.0075535	1.1220	1.9434	2.1289	5610	610
+2	1.5849	0.0095093	1.2589	2.1805	2.3886	6294	684
+3	1.9953	0.0119716	1.4125	2.4466	2.6801	7062	768
+4	2.5119	0.0150713	1.5849	2.7451	3.0071	7924	862
+5	3.1623	0.0189747	1.7783	3.0801	3.3741	8891	967
+6	3.9811	0.0238865	1.9953	3.4559	3.7867	9976	1085
+7	5.0110	0.030071	2.2387	3.8776	4.2477	11193	1217
+8	6.3096	0.037857	2.5119	4.3507	4.7660	12559	1366
+9	7.9433	0.047660	2.8184	4.8816	5.3475	14091	1532
10	10.000	0.060000	3.1623	5.4772	6.0000	15811	1720
11	12.589	0.075535	3.5481	6.1455	6.7321	17740	1929
12	15.849	0.095093	3.9811	6.8954	7.5536	19905	2165
13	19.953	0.119716	4.4668	7.7368	8.4752	22334	2429
14	25.119	0.150713	5.0119	8.6808	9.5094	25059	2725
15	31.623	0.189747	5.6234	9.7400	10.670	28117	3058
16	39.811	0.238865	6.3096	10.9285	11.972	31548	3431
17	50.119	0.30071	7.0795	12.2620	13.433	35397	3849
18	63.096	0.37857	7.9433	13.7582	15.071	39716	4319
19	79.433	0.47660	8.9125	15.4369	16.910	44562	4846
20	100.000	0.60000	10.0000	17.3205	18.974	50000	5438
21	125.89	0.75535	11.220	19.434	21.289	56105	6105
22	158.49	0.95093	12.589	21.805	23.886	62945	6840
23	199.53	1.19716	14.125	24.466	26.801	70625	7680
24	251.19	1.50713	15.849	27.451	30.071	79240	8615
25	316.23	1.89747	17.783	30.801	33.741	88915	9675
26	398.11	2.38865	19.953	34.559	37.867	99765	10850
27	501.19	3.0071	22.387	38.776	42.477	111935	12170
28	630.96	3.7857	25.119	43.507	47.660	125595	13660
29	794.33	4.7660	28.184	48.816	53.475	140915	15320
30	1000.00	6.0000	31.623	54.772	60.000	158110	17195
31	1258.9	7.5535	35.481	61.455	67.321	177405	19295
32	1584.9	9.5093	39.811	68.954	75.536	199055	21650
33	1995.3	11.9716	44.668	77.368	84.752	223340	24285
34	2511.9	15.0713	50.119	86.808	95.094	250595	27255
35	3162.3	18.9747	56.234	97.400	106.70	281170	30575
36	3981.1	23.8865	63.096	109.285	119.72	315480	34310
37	5011.9	30.071	70.795	122.620	134.33	353970	38490
38	6309.6	37.857	79.433	137.582	150.71	397160	43190
39	7943.3	47.660	89.125	154.369	169.10	445620	48460
40	10000.0	60.000	100.000	173.205	189.74	500000	54380
41	12589.2	75.535	112.20	194.34	212.89	561050	61050
42	15848.9	95.093	125.89	218.05	238.86	629450	68400
43	19952.6	119.716	141.25	244.66	268.01	706250	76800
44	25118.9	150.713	158.49	274.51	300.71	792460	86210
45	31622.8	189.747	177.83	308.01	337.41	889150	96690
46	39810.7	238.865	199.53	345.59	378.67	997650	108500
47	50118.7	300.71	223.87	387.76	424.77	1119350	121700
48	63095.7	378.57	251.19	435.07	476.60	1255950	136600
49	79432.7	476.60	281.84	488.16	534.75	1409150	153200
50	100000.0	600.00	316.25	547.72	600.00	1581100	171950

tions, such as corrosion, icing and oil. As there are differences in these methods of test and definition there cannot be exact equations between the IEC and NEMA classification codes, but because NEMA meet or exceed the IEC test requirements a cross reference can be made from NEMA to IEC. Figure 1, below, is a conversion of NEMA type numbers to IEC classifications, it cannot be used as a conversion of IEC to NEMA classification.

The tabulation, figure 2, is intended as a guide to determine or select an enclosure code using the IP system. For notation the letters IP are followed by two numbers. The first number is an indication as to the degree of protection to solid foreign objects, i.e. dust or fingers. The second number indicates the degree of protection to ingress of fluids i.e. water.

NEMA Type Number	IEC Classification
1	IP10
2	IP11
3	IP54
3R	IP14
3S	IP54
4 and 4X	IP56
5	IP52
6 and 6P	IP67
12 and 12X	IP52
13	IP54

Figure 1

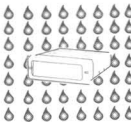
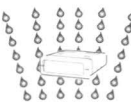
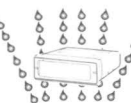
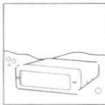
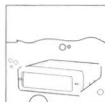
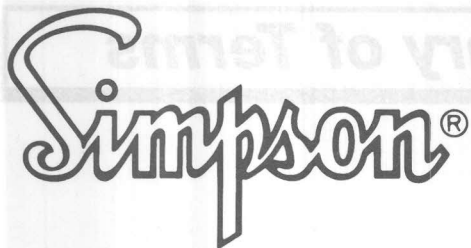
IP	TEST		
0	 no protection	0	 no protection
1	 protected against solid objects up to 50mm. e.g. accidental touch by hands.	1	 protected against vertically falling drops of water (e.g. condensation).
2	 protected against solid objects up to 12 mm e.g. fingers.	2	 protected against direct sprays of water up to 15° from the vertical
3	 protected against solid objects over 2.5 mm (tools & wires).	3	 protected against sprays to 60° from the vertical
4	 protected against solid objects over 1mm (tools, wires & small wires).	4	 protected against water sprayed from all directions - limited ingress permitted.
5	 protected against dust-limited ingress (no harmful deposit).	5	 protected against low pressure jets of water from all directions - limited ingress permitted.
6	 totally protected against dust.	6	 protected against strong jets of water (e.g. shipdecks - limited ingress permitted)
		7	 protected against the effects of immersion between 15 cm and 1 m.
		8	 protected against long periods of immersion under pressure.

Figure 2



Glossary of Terms

A

Absolute Zero

Theoretically, the lowest possible temperature. A body at absolute zero would have no molecular motion of heat energy. It is the zero point on the Kelvin and Rankine scales, and is estimated to be -273.15°C or -459.67°F .

AC

An abbreviation for alternating current; which refers to a current that reverses periodically with time and which has alternately positive and negative values.

Accuracy

The maximum deviation to be expected between a meter reading and the actual value being measured, under specified operating conditions. Usually expressed in percent of full scale for analog instruments, percent of reading for digital instruments.

A/D Converter

Analog to Digital converter. A circuit or device for producing a set of digital output signals representing the magnitude of a voltage applied to its input.

Air Damped

A construction utilizing an air vane to achieve movement damping. This vane is usually housed in a closed chamber to increase the damping action.

Alloy, Thermocouple

Any number of metal alloys having standardized and controlled thermoelectric properties. Designated dissimilar pairs of these alloys are used together to realize measuring or extension portions of thermocouple circuits.

Alpha

The temperature coefficient of resistance of a material, derived from measurements at 0°C and at 100°C :

$$\frac{R_{100} - R_0}{100 \times R_0}$$

It indicates the basic change in resistance in a material for each $^{\circ}\text{C}$ change in temperature. It is a defining parameter for resistance temperature detectors (RTD).

Example: Platinum per DIN 43760:
 $=0.00385$.

Ambient Temperature

The encompassing atmosphere, environment, air surrounding the equipment and instruments in use.

Ampere

A unit of electric current which expresses the force with which current flows.

Analog

Electrical quantities having the property of varying in a continuous, rather than incremental or discrete-step manner.

Analog Panel Meter

A scale and pointer, capable of indicating a continuous range of values from zero to the rated full scale value.

ANSI C39.1 Standard

American National Standards Institute, Inc. Standard C39.1. Applies to analog instruments, defining nomenclature, test conditions and procedures, general construction requirements, mounting dimensions, and performance requirements.

Auto-Polarity

In digital instruments, the ability to measure DC values of either polarity of the measurement without the need to interchange test lead connections.

Auto-Zero

In digital instruments, the automatic updating of an error integrating/memory circuit prior to each measurement, eliminating the effects of zero offset and drift, resistance tolerance and drift, and time-constant tolerance and drift in the instrument circuits.

Average Responding

The measurement of an AC voltage or current obtained using a DC instrument with a rectifying input circuit that converts AC energy to DC. The meter scale or readout is usually calibrated in terms of the corresponding RMS values, but is accurate only for pure sine wave inputs.

B

Balance (Position Influence)

The change in the position of the pointer from zero when the axis of the moving element moves from the vertical position to the horizontal position. The Balance is expressed as a percentage of scale length

BCD, Parallel

A digital data output format where every decimal digit is represented by binary signals on four lines and all digits are presented in parallel. The total number of lines is 4 times the number of decimal digits.

BCD, Serial

A digital data output format where every decimal digit represented by binary signals on four lines and up to five decimal digits are presented sequentially. The total number of lines is four data lines plus one strobe line per digit.

BCD, Three-State

An implementation of parallel BCD, which has 0, 1 and high impedance output states. The high impedance state is used when the BCD output is not addressed in parallel connect applications.

Bias Current

A very low level DC current generated by digital panel meters and superimposed on the signal. This current may introduce a measurable offset across a very high source impedance.

Bipolar

The ability of a panel meter to display both positive and negative readings.

Burden

The electrical load taken from a circuit by measuring instruments expressed in volt-amperes (VA) or watts. In current transformers burden in VA is the maximum load the transformer can support while operating within its accuracy rating.

C

Calibrate

To determine the indication or output of a device with respect to a standard.

Callendar - Van Dusen Equation

An interpolation equation which provides resistance values as a function of temperature for RTDs.

Celsius Temperature Scale

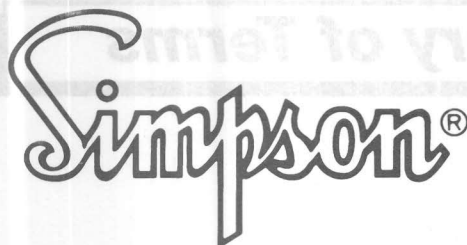
A temperature scale with the ice point at 0° and the boiling point of water at 100° . The formula for conversion to the Fahrenheit scales is $F = 9/5 (C+32)$. Formerly referred to as "Centigrade."

CMR (Common-Mode Rejection)

Common-Mode Rejection states the ability of a DVM to reject noise which appears between the input terminals (high and low) and ground. CMR is needed only when the DVM ground is different from the ground source being measured. When a DVM is operated from line source of power or when both high and low inputs are raised above ground, coupling (impedance) paths exist which introduce noise. Highest CMR exists in a battery operated DMM. Particular care should be taken when data outputs are used. For above ground measurements, data outputs and inputs must be isolated through the use of transformers or opto-isolation.

CMV (Common-Mode Voltage)

Common-Mode Voltage specifies the DC voltage which is tolerable between input and low and power ground. CMV specifica-



Glossary of Terms

tions are typically a few volts at most. However, using batteries or a transformer isolated power supply permits an instrument to be operated at a higher CMV, usually on the order of 100 VDC.

Cold Junction Compensation

In thermo instruments, the automatic correction for ambient temperature changes at the cold junction of the thermocouple, which would normally cause erroneous readings.

Conformity Error

For thermocouples and RTDs, the difference between the actual reading and the temperature shown in published tables for a specific voltage input.

Constantan

The negative leg of types E, J, and T thermocouples. Constantan is 55% copper and 45% nickel. The EMF values can be significantly different for this material depending upon with which type of thermocouple alloy it is intended to be matched.

Conversion Rate

The number of analog to digital conversions performed per second by a DPM.

Counts

The number of time intervals counted by the dual slope A/D converter and displayed as the reading of the panel meter, before addition of the decimal point.

Crest Factor

The ratio of peak voltage to the RMS voltage of waveform (with the DC component removed).

Current

The movement of electrons through a conductor. Measured in amperes, and its symbol is I.

Damping Factor

The ratio of the deviations of the pointer in two consecutive swings from the position of equilibrium, the greater deviation being divided by the lesser. The deviation are expressed in angular degrees. (The use of this term is depreciated. Use overshoot which is the reciprocal of the damping factor). See overshoot.

D'Arsonval Movement

A meter movement consisting of a small, lightweight coil of wire supported on jeweled bearings between the poles of a permanent magnet. When the direct current to be measured is sent through the coil, its magnetic field interacts with that of the permanent magnet and causes the coil and attached pointer to rotate.

Decibel (dB)

A logarithmic unit for the expression of the ratios of two amounts of power. The number of decibel denoting such a ratio to 10 times the LOG of the ratio.

$$\text{dB} = 10 \text{ LOG}_{10} \times P_1/P_2$$

Deadband (Hysteresis)

In a digital controller, there may be one switching point when the signal increases and another switching point when the signal decreases. The difference between the two switching points is called hysteresis or deadband.

Dielectric

A material with low electrical conductivity. The insulation between two conductors is a dielectric if it can support electrostatic stresses across it.

Dielectric Strength

A measure of the voltage that an insulating material can withstand before an electrical breakdown occurs. It is sometimes referred to as breakdown potential.

Digit

A measure of the display span of a panel meter. By convention, a full digit can assume any value from 0 to 9, a 1/2 digit will display at 1 and overload at 2, and a 3/4 digit will display digits up to 3 and overload at 4, etc. For example, a meter with a display span of ± 3999 counts is said to be a 3-3/4 digit meter.

DIN (Deutsche Industry Norm)

A set of German standards recognized throughout the world. The 1/8 DIN standard for panel meters specifies an outer bezel dimension of 96 x 48 mm and a panel cutout of 92 x 45 mm.

Diode

Device that allows current to flow in only one direction.

Drift

A variation in a reading or set point value resulting from changes in component value, ambient temperature and line voltage.

Dual-Slope Conversion

A digital technique for converting a measures analog quantity to a precise digital equivalent, for display as a numerical value. During a fixed interval of time, the output of an integrating circuit rises linearly at a rate proportional to the measured analog input quantity. The circuit input is then switched to a precise reference-voltage source of opposite polarity, causing the output to descend at a fixed rate, while a counting circuit clock counts pulses delivered by an internal pulse generator. As the integrator output reaches its base level, the count is terminated; the total count (numerically equivalent to the analog input quantity) is then displaced in a digital readout as a voltage, current, resistance, or other parametric quantity.

E

Electromotive Force (EMF)

An electrical potential difference which produces or tends to produce an electric current. The unit of measure is volts.

End Scale Value

The end scale value of an instrument is the value of the actuating electrical quantity that corresponds to end scale indication. When zero is not at the end or at the electrical center of the scale, the higher value is taken.

Expanded Scale

An arrangement that expands a specific position of an overall range to occupy a larger portion of the full scale length than it normally would.

F

Fahrenheit Temperature Scale

A temperature scale with the ice point at 32° and the boiling point of water at 212°. The formula for conversion to the Celsius scale is: $C = 5/9 (F - 32)$.

FEP

An abbreviation for Fluorinated Ethylene Propylene. This component is commonly referred to as "Teflon."

Fiducial Value

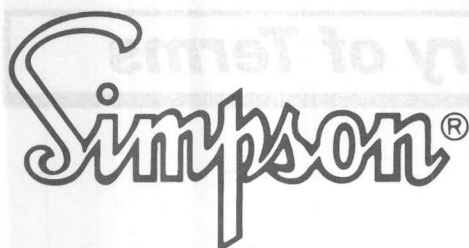
The value to which reference is made in order to specify the accuracy of an instrument. When the mechanical zero is at one end of the scale or outside the scale, the

Damping

The manner in which the pointer settles at its steady indication after a change in the value of the measured quantity. There are two general classes of damped motion, as follows:

1. **Periodic**, in which the pointer oscillates about the final position before coming to rest.

2. **Aperiodic**, in which the pointer comes to rest without overshooting the rest position. The point of change between periodic and aperiodic damping is called "critical damping." An instrument is considered to be critically damped when overshoot is present but does not exceed an amount equal to one-half the rated accuracy of the instrument.



Glossary of Terms

fiducial value corresponds to the higher end-scale value. When the mechanical zero is displaced within the scale, the fiducial value is the arithmetic sum of the absolute electrical values corresponding to the two limits of the range.

Frequency Response

A measure of how effectively a circuit or device transmits the different frequencies applied to it.

Frequency Influence

The change in indication due solely to a frequency change of the applied energy from a specified frequency. Frequency influence is usually expressed as a percentage change of full-scale value for a specified frequency change.

Friction

The difference between tapped and untapped meter readings due to the combination of pivot friction and pivot roll. Friction is usually checked by making a substantial change in the applied energy (5-10%) at a sufficiently slow rate so that no overshoot occurs. The meter indication is then noted and, maintaining the same energy level, the meter is tapped. The difference between the two indications is the friction error. It is customary to express the error as a percentage of full-scale value.

Full-Scale Value

The arithmetic sum of the two end-scale values. When zero is not on the scale, the full-scale value is the higher end-scale value.

G

Gas Discharge Display

In digital instruments, a numerical readout in which the digit segments are delineated by the glow of ionized gas. Also described as "plasma" or "gas plasma" display.

Grounded Junction

A specific type of thermocouple junction in which the sheath and conductors are welded together forming a completely sealed integral junction. A grounded junction is recommended for use in liquids, gas, and high pressure environments.

H

Hold

Meter HOLD is an external input which is used to stop the A/D process and freeze the display. BCD HOLD is an external input used to freeze the BCD output while allowing the A/D process to continue operation.

Hysteresis

An error resulting from the inability of an electrical signal or mechanical system to produce the same reading or position when approached slowly from either direction. Also referred to as deadband.

HZ

Abbreviation for hertz — the new term used in place of cycles per second.

I

Input Impedance

The resistance and reactance of a panel meter. In case of a voltmeter, this impedance has to be taken into account when the source impedance is high.

Iron Vane

An instrument comprising a movable piece of ferromagnetic material that is actuated by a fixed coil carrying a current or by a fixed piece of ferromagnetic material magnetized by the current.

J

Junction (Thermocouple)

The point at which two thermocouple alloys are joined. In a typical thermocouple circuit there is a measuring junction and a reference junction.

K

Kelvin Temperature Scale

Also known as the thermodynamic temperature scale, the Kelvin Scale is an absolute temperature scale in which temperature differences are proportional to the amount of heat energy converted to mechanical work by a Carnot engine. The ice point on the Kelvin Scale is 273.15 K. A useful approximation for conversion of the Kelvin Scale to the Celsius Scale is:

$$T(K) = T(C) + 273.15$$

Kilo

A prefix meaning thousand of 10^3 . The symbol is K.

Knife-Edge Pointer

Analog meter pointer with end flattened and turned edgewise so that the thinnest dimension or edge is seen by the observer. Often used with a mirror-backed scale for increased reading accuracy by elimination of parallax.

L

LCD Display

A numerical readout in which the digit segments are delineated by dark areas in a liquid-crystal display.

ments are delineated by dark areas in a liquid-crystal display.

Lead Length Consideration

Connecting leads can affect the accuracy of small current transformers, DC shunts and low voltage analog voltmeters. Use leads supplied with device or lead size specified.

LED Display

A numerical readout in which the digit segments are delineated by light emitting diodes.

Linearity

A measure of the departure from a straight line response in the relationship between two quantities, where the change in one quantity is directly proportional to a change in the other quantity. Usually expressed as a maximum percent.

Loop Resistance

The total resistance of the thermocouple materials in a thermocouple circuit.

LSD (Least-Significant Digit)

The right-most active digit of the display.

M

Magnetic Influence

The influence that is caused solely by an external magnetic field which is produced with a current of the same kind and frequency as that which actuates the mechanism.

Magnetically Damped

Meters in which the damping is achieved by moving a metal vane through a magnetic field. The motions induces currents in the vane which sets up magnetic fields opposing those of the stationary magnets thus tending to bring the pointer to rest. This type of damping is found in many quality moving iron and dynamometer type instruments.

Measuring Junction

That junction of a thermocouple subjected to the temperature to be measured.

Mega

A prefix meaning million or 10^6 . The symbol is M.

Micro

A prefix meaning one millionth or 10^{-6} . The symbol is μ .

Microprocessor

The small central processing unit (CPU) that performs the logic operations in a micro-

Milli

A prefix meaning one thousandth or 10^{-3} . The symbol is m.

Mineral Insulated Thermocouple

A thermocouple probe constructed by loading the metal sheath with thermocouple conductors and a mineral-based dielectric material; and then compacting the entire assembly.

Mirror Scale

Analog meter scale with a mirror arc that enables alignment of the eye's line of sight perpendicular to the scale when taking a reading. Eliminates parallax, considerably improves reading accuracy.

MSD**(Most Significant Digit)**

The left-most digit of the display.

Multiplex

A technique which allows different input (or output) signals to use the same lines at different times, controlled by an external signal. Multiplexing is used to save on wiring and I/O ports.

Multiplier

A series resistor that is used to extend the voltage range beyond the particular value for which the instrument is designed.

N**Nema-4**

A standard from the National Electrical Manufacturers Association, which defines enclosures that are intended for use indoors to protect the enclosed equipment against splashing water, seepage of water, falling or hose directed water, and severe external condensation.

NMR (Normal-Mode Rejection)

The ability of a panel meter to filter out noise superimposed on the signal and applied across the SIG HI to SIG LO input terminals. Normally expressed in db at 50/60 Hz.

Noise

Unwanted electrical interference picked up on a signal cable.

O**OHMS Per Volt**

Indication of the total terminal resistance of an analog voltmeter. A measure of the sensi-

Opto-Isolator

An isolation device that provides an electrical barrier between related circuits.

Overload Rated

The maximum load over a full scale value that an instrument can withstand without damage or failure. Expressed as a percent of a full scale value.

Overload Capacity

The level of current, voltage or power beyond which a device will be ruined. It is usually higher than the rated load capacity.

Overrange

In digital meters, a reading that exceeds full scale (but is less than an overload) that does not require switching to higher range, i.e. for 3-1/2 digit DPM 0-999 is full scale rating. 1000-1999 is overrange. 2000 and up is overload.

Overshoot

The ratio of the overtravel of the pointer beyond a new steady deflection to the change in steady deflection when a new constant value of the measured quantity is suddenly applied. The overtravel and deflection are determined in angular measure and the overshoot is usually expressed as a percentage of scale length.

P**Parallax**

The seeming displacement of an object and its background when viewed from two different points of observation.

Peak Hold

An instrument function that permits retaining and displaying the peak value momentarily reached by a pulse or other brief signal under measurement.

Peak Voltage

The maximum value present in a varying or altering voltage. This value may be either positive or negative.

Phase Angle

The difference in degrees by which the voltage wave lags or leads the current wave in an AC circuit.

Pivot and Jewel

Method of suspending a moving coil or moving iron vane in a magnetic field, in analog meters. The moveable element is

Polarity

An electrical occurrence which determines the direction in which current tends to flow.

Position, Influence:

The influence that is caused solely by the departure of an instrument from its normal operating position.

Power Consumption

The power necessary to produce end scale deflection of the meter. Power consumption may be expressed in wattage, voltage, volt-amperes, or current.

Power Factor

The cosine of the phase angle between the voltage applied to a load and the current passing through it.

Process Meter

A panel meter with sizeable zero and span adjustment capabilities, which can be scaled for readout in engineering units for signals such as 4-20 mA, 10-50 mA, and 1-5 V.

R**Range (Full Scale)**

The range of signal input which can be measured before the instrument goes into overload condition.

Rectifier-Type Instrument

A DC instrument equipped with a solid-state rectifier at its input to convert AC energy to DC energy. The instrument provides measurements of the average value of an AC voltage or current, and its scale is usually calibrated in terms of the RMS equivalent.

Reference Junction

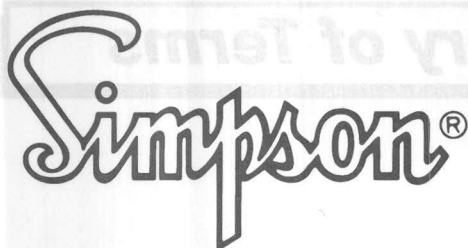
The junction in a thermocouple circuit which is maintained at a constant, known temperature. It is also referred to as the cold junction and as a standard it is usually maintained at 0° C, however, any temperature can be used.

Repeatability

The ability of an instrument to repeat its indications when the pointer is deflected upscale, compared to the indications taken when the pointer is deflected down-scale, expressed as a percentage of the fiducial value.

Resistance

A property of conductors which determines the current produced by a given difference



Glossary of Terms

of potential. Dimensions, materials and temperature all influence resistance.

Resolution

The degree to which nearly equal values of a quantity can be discriminated. In analog meters, the difference between the values represented by two adjacent scale divisions. In digital meters, the value represented by a one digit change in the least significant digit.

Response Time

In analog instruments, refers to the time required after an abrupt change of the measured quantity to a new constant value until the pointer, or indicating means, first comes to apparent rest in its new position. In sensors, it refers to the time required for a sensor to reach 63.2% of the step change in temperature for a particular set of test conditions.

RS232C Output Signal

A serial interface suitable for connection between a digital controller and a personal computer, a host computer, or a printer.

RS422A Output Signal

A serial interface suitable for connection between a digital controller and a personal computer, a host computer, or a printer.

RTD

An abbreviation for resistance temperature detector. It is a circuit element whose resistance increases with increasing temperature in a predictable manner. Platinum is the most popular material, however, copper, nickel, balco, and tungsten are also used in RTDs. Connected via 2, 3, or 4 wire hookups.

S

Scale Length

The length of the path described the indicating means of the tip of the pointer in moving from one end of the scale to the other. In the case of knife-edge pointers and others extending beyond the scale division marks, the pointer shall be considered as ending at the outer end of the shortest scale division marks. In multiscale instruments the longest scale shall be used to determine the scale length.

Scaling

For direct read out in engineering units, the capability of the meter to associate any desired value to the electrical input range.

Self Contained Instrument

A self contained instrument is one in which no accessory items are required to perform its intended function(s). If not specified, a manufacturer may optionally supply either a

self contained meter or one with external accessories.

Self-Shielding

Shielding that is inherent in the construction of an instrument, protecting it from the influence of external magnet and/or electrostatic fields.

Sensitivity

For current measuring instruments, the ability to respond to small signals; the lower the full scale range, the greater the sensitivity. For voltage measuring instruments, the higher the ohms per volt, the less will be the current consumed from the circuits.

Shunt

A calibrated low resistance connected in parallel with the input terminals of an ammeter in order to enable measurement of wider range of currents. It can be internal or external, typically, external shunts are normally either 50 or 100 mV rated.

Span Adjustment

The ability to adjust the gain of a process or strain meter so that a specified display span in engineering units corresponds to a specified signal span. For instance, a display span of 200°F may correspond to the 16 mA span of a 4-20 mA transmitter signal.

Spare

A connector point reserved for options, special, or other configurations.

Span Range

The span between two points anywhere within a temperature or voltage limit that a recorder can be calibrated to. FORMULA: Maximum temperature (mV)-minimum temperature (mV) = span.

Stability

The ability of an instrument or a sensor to maintain a consistent output or indication with the application of a constant input.

Suppressed Zero

An instrument in which a portion of the range from zero to a given value is not visible on the scale, e.g., 4-20 mA. Suppression can be done by mechanical means or by instrument circuitry.

Symmetry

(Applies only to offset zero meters)

The measure of a meter's ability to provide corresponding indication on each side of zero when the polarity of the applied energy is reversed. Symmetry error is customarily expressed as a percentage of actual full scale value.

Symmetry Error

The difference in indications when the polarity of a measured quantity is reversed, expressed as a percentage of fiducial value.

T

Taut-Band

A method of suspension of the moving element in an analogmeter movement using metal bands under tension. The bands provide the suspension and the restoring torque during reflection, without the friction inherent in jewel-bearing suspension.

Teflon/Tefzel™

Medium temperature wire insulation's useful to 500°F and 390°F, respectively. Tefzel has some radiation resistance. TEFLON/TEFZEL is a trademark of DuPont.

Tempco

Abbreviation for "temperature coefficient": the error introduced by a change in temperature. Normally expressed in % / °C or ppm / °C.

Temperature Influence

The change in indication due solely to a change in ambient temperature from a specified reference temperature. Temperature influence is usually expressed as a percentage of full scale value for a specified temperature change.

Temperature Limit

The full capability of the system from the lowest point to the highest point: limited by the sensor.

Thermocouple

A temperature sensor formed by joining two dissimilar metals and applying a temperature differential between the measuring junction and the reference junction.

Thermocouple Break Protection

A device for sensing malfunction when a thermocouple opens up or breaks down during operation, acting to latch the high set point and shut down the system, or display an alarm.

Torque

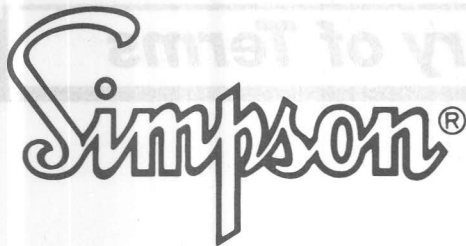
A rotational movement applied to the moving system. At a steady state of deflection, the mechanically applied torque is equal and opposite to the electrically developed torque. Torque is usually expressed in millimeter grams for a given angular deflection.

Tracking

The ability of an instrument to indicate at the scale mark being checked when energized by the proportional value of actual end-scale excitation.

Tracking Error

The error in indication at a scale mark, expressing in percentage of fiducial value, when the instrument is energized by the



Glossary of Terms

proportional value of the actual end-scale excitation.

Transformer (Instrument)

Performs the two principle functions of multiplying the range of the instrument and insulating the instrument from a high voltage circuit.

Transformers (Current)

(CT) usually have toroidal type cores of high permeability materials operating at a low flux density. They all have wound secondaries usually rated for 5 amperes AC. When the primary is prepwound on the core, a tap arrangement is provided giving a choice of input currents. Alternately, the primary can be one or more turns of a conductor passing through the "window" of the toroid. An ammeter is connected to the secondary. The secondary meter circuit should never be opened when current is flowing.

Toroidal current transformers contain secondary windings only, with their connections brought out to terminals on the housing. They are provided with a central opening through which one or more turns of wire are inserted to act as the primary, for connection to the circuit under measurement. Primary/secondary turns ratios can be adjusted by increasing or decreasing the number of inserted primary turns, and also by inserting one or more turns of the secondary leads (connections to the ammeter) through the core opening.

Transducer

A device which receives and transmits energy. In many instances, the energy which is received is transmitted in a different form.

Transmitter

A device used to retransmit a temperature reading from either a thermocouple (voltage) or RTD (resistance) as a current signal, by way of a two-wire loop. The loop has an external power supply and the transmitter acts as a variable resistor with respect to its input signal. Transmitters are desirable when long lead or extension wire runs would produce unacceptable signal degradation;

and can transmit their signals on ordinary copper wires.

True RMS

The true root-mean-square value of an AC or AC plus DC signal, often used to determine power of a signal. For a perfect sine wave, the RMS value is 1.11072 times the rectified average value, which is utilized for low cost metering. For significantly nonsinusoidal, a true RMS converter is required.

U

UL

An abbreviation for Underwriters Laboratories Inc. UL is an independent organization devoted to testing for public safety.

UL Ratings

The Underwriters Laboratories were instituted to perform tests on materials, components, apparatus, and installations, and to establish safe standards based on these tests. They validate components, devices, and their combinations for industrial, commercial, and consumer applications of all kinds by checking them against these standards. They "recognize" and they "list."

UL Recognized Product

A product which has been produced under UL's Recognition and Follow-Up Service and which bears the authorized Recognized Markings as the manufacturer's declaration that the product complies with UL's requirements in accordance with the terms of the Recognition and Follow-Up Service Agreement.

UL Listed Product

A product which has been produced under UL's Listing and Follow-Up Service and which bears the authorized Listing Mark of UL as the manufacturer's declaration that the product complies with UL's requirements in accordance with the terms of the Listing and Follow-Up Service Agreement.

Ungrounded Junction

A thermocouple junction which is fully insulated from the capped sheath end. An un-

grounded junction is often specified for applications involving frequent or rapid temperature cycling, and, for protection against stray emf signals.

Unipolar

In digital instruments, a capability for measuring voltage or current of only one polarity.

V

Volt

The unit of measurement of electromotive force.

Volume Unit or V.U.

A logarithmic unit for the expression of the ratios of two amounts of power, equal to a decibel when a reference level of one milliwatt at 600 ohms is used.

Volt Ampere(s)

The product of the RMS Voltage applied to a circuit and the RMS current, in amperes, flowing through it.

W

Watt

Unit of electrical power. Watt = EI x PF.

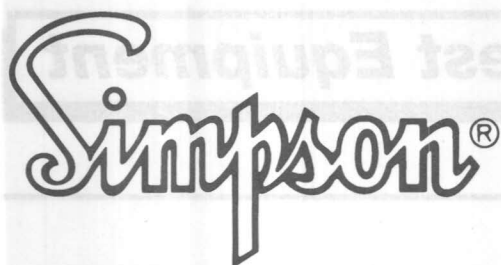
Z

Zero Adjustment

The ability to adjust the display of a process or meter so that zero on the display corresponds to a non-zero signal, such as 4mA, 10mA or 1 VDC. The adjustment range is normally expressed in counts.

Zero Drift

The maximum deviation from zero reading of a meter having zero input over a given temperature range. Expressed as a percent of full-scale reading per degree centigrade.



Test Equipment

Digital and Analog

Simpson Has the Finest Test Equipment for Every User:

- Designers
- Engineers
- Students
- Technicians
- Electricians
- Teachers
- Inspectors
- Assemblers
- Hobbyists
- Scientists
- Environmentalists
- Experimenters

The New Old Faithful



DIGITAL & ANALOG MULTIMETERS

Simpson leadership in test equipment continues with its latest generation of digital and analog multimeters.

When performance is required that even the best general-purpose digital multimeters cannot offer, Simpson's world-famous 260 series of analog multimeters provide:

- Lab accuracy with rugged construction for field use
- Quick, easy nulling and peaking adjustments
- Diode network meter movement protection
- AC frequency response to 100 kHz
- Large tri-colored mirrored scale
- Instant trend information for quick positive yes/no checks
- Zero RFI emissions
- UL 1244 listing
- Audible continuity check
- Mirrored scales for parallax reduction.

Simpson's full line of Digital multimeters combine superior performance and versatility in both hand held and bench top models. Simpson DMM's also have:

- Advanced data-hold and peak-hold capability for maximum transient readings
- LCD readout
- Audible self-test — operational readiness and fuse check
- Millivolt range for direct reading of thermocouple output
- Wide dynamic range
- High-speed bar graph display to catch a momentary change of measurement
- Relative measurement from standard measured values
- Data memory
- Frequency and capacity measurement
- Continuity beeper and diode testing
- Optional photocell recharging
- Autoranging capabilities.

CLAMP-ON METERS

Simpson continues to be the source of the very best in clamp-on equipment.

Features include:

- Autoranging up to 1000 amps
- 0.01 ampere resolution on 20-amp range
- Accuracy ± 1 percent of range through 400 Hz
- Surge-hold function for starting currents and power surges
- 0.625-inch high-visibility LCD
- Automatic shutoff to conserve energy
- True RMS or true average measurement
- Current measurement without power interruption
- Clamp-on conductor
- Connection to digital multimeters or analog VOMs.

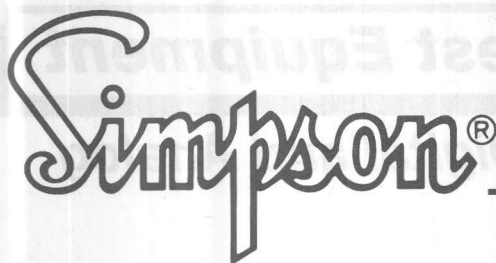
Top-of-the-Line AC/DC Clamp-On Hall Effect Ammeters

Model HE-94



Model 159
AC/DC Amp-Clamp
Adapter





Test Equipment

SOUND/DOSIMETRY

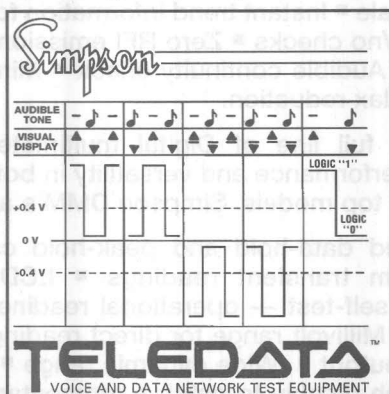
Simpson delivers sound-level and dosimetry systems for every requirement.

Simpson sound-level systems:

- Meet IEC 651 and ANSI S1.4-1983 meters (ANSI S1.4 1992 pending) ■ Help in meeting OSHA and Walsh-Healy noise control specification ■ Quickly and accurately measure sound levels in factories, offices, stores, theaters, studios and construction sites ■ AC and DC voltage output jacks interface with recorders, analyzers and other testers ■ Full-coverage 40-140 dB with special 85-115 dB OSHA range ■ Type II measurement.

Simpson's sound dosimetry system offers:

- Conformance with all applicable specifications ■ Choice of exchange rates (3, 4 or 5 dB) and criterion levels (70, 80, 84, 85 or 90 dB) ■ Selectable threshold level from 50-99 dB in 1-dB increments ■ Dual range (50-100 dB and 80-130 dB) ■ More than 30 hours of internal data-storage capacity.



SPECIAL TESTERS

Today, as always, Simpson leads in designing testers for special applications.

- Simpson's Model 228 is a special-purpose AC/DC milliammeter specifically for measuring hazardous "leakage currents" or "test currents" which may appear when a person touches the conductive surface of electrical or electronic equipment. Reading in Measurement Indication Units (MIU) to .005 MIU, it conforms with new IEC, ANSI and UL guidelines.
- Simpson's 380M microwave leakage tester provides the ability to quickly determine whether leakage from consumer microwave ovens and microwave-based industrial ovens and dryers exceeds federal safety standards.

Simple,
Accurate
Sound
Measurements



TELECOMMUNICATION TESTERS

Simpson testers are FIRST in the Teledata market, a position they have occupied for more than 40 years.

There are good reasons. Simpson Teledata equipment:

- Is designed specifically for telecom applications ■ Provides a wide measuring range ■ Assures a shorter testing time ■ Is built rugged, with field use in mind ■ Always gives accurate readings ■ Simpson's Model 8455 now has field-replaceable switches. Broken switches can be replaced in less than the time required to complete a field report or repair paperwork. Simpson uses the very best toggle switches, with pinned toggles for longer life.

**US and Int'l Agencies Change Rules
for Electrical Current Leak Testing
Affects Electrical Equipment Makers**

The International Electrotechnical Commission (IEC) and the American National Standards Institute (ANSI) have established new methods for testing AC current leakage in electrical equipment, such as 120 volt household appliances, telephone equipment, etc.

Special uniform measurement circuits have been specified to test compliance with new specifications, including IEC-990, IEC 1010-1, ANSI C101.1 and UL 1459. Electrical equipment manufacturers and testing agencies will have to use these new circuits in their product testing.

The new circuits require special precision networks and new instruments for measuring Perception/Reaction response. Let Go response and Electrical Burn. The Simpson Electric Model 228 includes all these circuits in one instrument.

**Leakage
Current Tester**



Model 228

FOR MORE INFORMATION ABOUT SIMPSON TEST EQUIPMENT AND ACCESSORIES CALL 1-708-697-2260

Profiles in Quality

Advanced Technology

The Situation: Hewlett Packard requires panel meters for use in the power supplies they manufacture. Of particular importance to HP is that units be extremely accurate.

The Solution: Simpson Electric is presently delivering more than 5,000 panel meters and power supplies to Hewlett Packard each year, and has been an HP supplier for more than twenty years.

According to Jack Femmel, National Sales Manager at Simpson Electric, quality management isn't just a business concept at HP, it's a way of life:

"With HP, you have to perform day in, day out, because they have outstanding measuring systems. They measure everything. They measure performance. They measure delivery. They measure everything. When we meet with HP, we're talking about how to improve our processes — it's not a one-way thing. If you become their supplier, you are truly their business partner, too."

Metal Fabrication

The Situation: Until recently, quality control processes in place at *Interlake* included a visual inspection of welds to ensure that steel storage racks were being properly constructed. However, as part of Interlake's continuing process improvement program, the firm decided to augment visual inspection through the development of an automated weld monitoring system. Interlake required a panel meter/controller that could accurately monitor current and interface effectively with their welding system's PLC.

The Solution: After evaluating various alternatives, Interlake decided to purchase 27 Simpson Hawk controllers. Nine Simpson Hawk controllers were purchased for use with each of three welding machines. Hawk controllers are now used to monitor the weld current on Interlake systems. In the event the weld current exceeds 200 amps, a message is sent to the welding unit's PLC indicating weld failure, and the welding unit shuts down.

Simpson's Hawk Series indicator/controllers have proven popular because they are ideal for measuring and controlling a variety of process variables. Hawk displays can be easily scaled via the front panel to virtually any engineering units.

Digital scaling, offset and full scale calibration eliminate zero and span drift. Hawk Controllers provide an excellent choice of input/output combinations to resolve measurement and control problems. They are ideal for high accuracy measurements and monitoring a variety of process variables.

Models are available which measure AC and DC voltage/current, TRMS AC voltage/current, resistance, 3-wire potentiometer, frequency, tachometer (RPM), and temperature (RTD and thermocouple outputs).

Automotive

The Situation: One important task of Ford's fuel handling division is to evaluate fuel pump performance. One part of this process was the development of ten fuel pump test chambers for use during research and development testing in Dearborn and in other locales throughout the United States. These test chambers are used to measure various aspects of fuel pump performance, while pumps are tested at different criteria. As part of this process, Ford needed to select a digital panel meter that would deliver excellent accuracy as well as field scalability.

The Solution: After evaluating various alternatives, Ford purchased 100 Hawk indicator/controllers for use in their ten fuel pump testing chambers. Simpson's Hawk Series indicator/controllers have proven popular because they are ideal for measuring and controlling a variety of process variables. Hawk displays can be easily scaled via the front panel to virtually any engineering units. Digital scaling, offset and full scale calibration eliminate zero and span drift. At Ford, Hawk Series indicator/controllers are used to measure the voltages of newly designed fuel pumps still in the testing stage.

According to Jack Femmel, National Sales Manager at Simpson, Ford selected the Hawk due to ease of use issues.

"It is very easy to scale. It's a 0-20 volt instrument and you can scale it properly. It's very flexible. They liked what they saw, and the Hawk fit their application."

Hawk On/Off Controllers/Indicators provide an excellent choice of input/output combinations to resolve measurement and control problems. They are ideal for high accuracy measurements and for monitoring a variety of process variables.

Models are available which measure AC and DC voltage/current, TRMS AC voltage/current, resistance, 3-wire potentiometer, frequency, tachometer (RPM), and temperature (RTD and thermocouple inputs.)